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December 1954 No. 12

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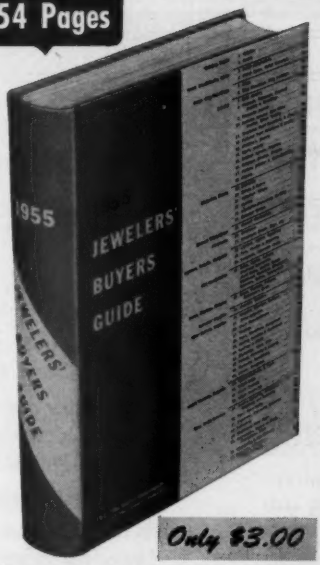


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# The American horologist and jeweler

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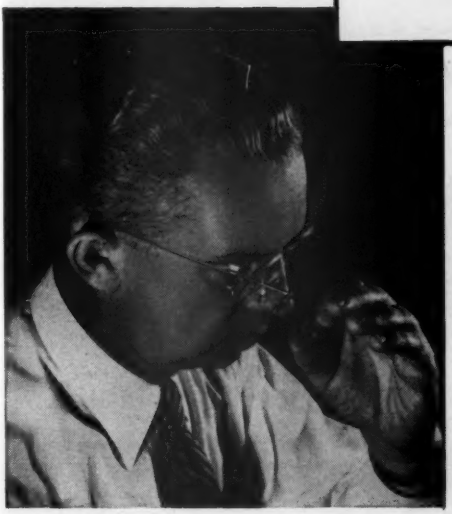

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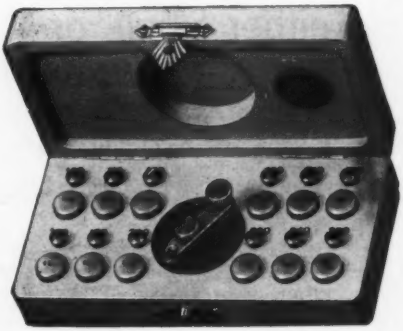

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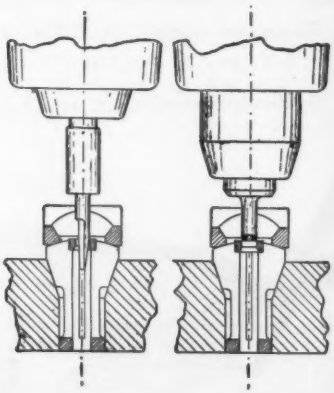

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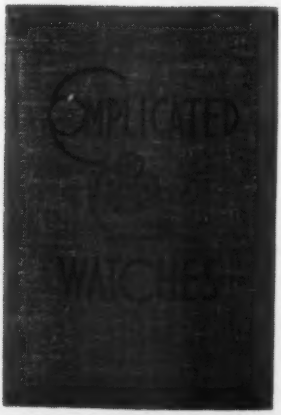


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**" . . . There's something new under the sun after all"**

# A. H. & J.'s "New Look"

Recently we received a letter from a young watchmaker who had just completed two years of military service. During that time, he said, he kept up his subscription to A. H. & J., but found no time to read it. Then, upon returning to his bench, the first thing he did was to read every copy. His letter expressed great astonishment over the progress in his craft which had occurred during the past two years—the introduction of new calibers, unbreakable mainsprings, new tools and equipment, new servicing methods, concerted selling, etc." There's something new under the sun after all!" he wrote.

Naturally we were pleased with the young man's letter, and it made us think. True, we were peddling our own merchandise—fresh news and developments in the trade—to the best of our ability, but in a package that has remained unchanged for six years. Now, we all know that isn't right. If a jeweler doesn't change his window dressing regularly, the public will lose interest in his display. So, A. H. & J. went through a clinical analysis, and came up with a new prescription for typographical design.

The "new look" will begin with the January 1955 issue of A. H. & J. There won't be any radical changes . . . there will still be the same departments with the best technical material in the field, the same distinctive color-of-the-month, the same size because we think it is the best size for the purpose A. H. & J. is intended—a working magazine. But the contents will be streamlined, easier to read and simpler for the reader to select his favorite subjects.

A. H. & J.'s "new look", beginning January, 1955, was engineered just for you. We hope you like it!

**The Editors**
**AMERICAN HOROLOGIST & JEWELER**

The American horologist and jeweler Incorporating Horology

Volume 21 December, 1954 No. 12

# How to Reduce Comebacks To a Minimum

## Lecture 4
## ASSEMBLING A WATCH

By DR. H. ATLANTIS SUDBURY

From a recent series of 13 lectures delivered before the Horological Assn. of California. (All rights reserved.)

THE balance wheel and hairspring have been trued up on the plate, and then carefully laid aside. The assembling of the remaining parts of a watch follows a common pattern. The detent screw is first put in place—then the mainspring barrel, train wheels (beginning at the escape wheel), main bridge and train bridge—then screwed down. It is while putting the train bridge in place that many escape wheel pivots are slightly bent. We selected ten at random and found eight slightly bent—enough to stop the watches before they were run down. Keep the wheels upright while putting the bridge in place. Do not wobble them around.

Put a little oil on all bridge pivots, including the mainspring arbor. Put on ratchet wheel and crown wheel after slightly oiling the hub of the crown wheel. Test the freedom of the train by turning the ratchet wheel half a turn. If the escape wheel does not backlash it may be due to a weak click spring, so turn the ratchet wheel again and hold it. If the escape wheel still does not backlash, the trouble must be in the train, because we have already checked and greased the mainspring. Check for a bent pivot or insufficient end shake. There are very few watches that will not backlash if cleaned properly, not oiled too much, and have the right strength mainspring. It is imperative to have perfect freedom of gears. This must be attained before we go to the next operation.

Turn the watch over and put the winding wheel and clutch in place. Some watch repairers use oil on the stem, winding pinion and clutch; others use grease similar to what we used on the mainspring, maintaining that the grease will not run to other parts and also prevents water from getting into the watch through the stem, which is very good reasoning. Whichever you use, however, be sure to oil or grease the ratchet teeth between the clutch and winding wheel, the point of contact between the detent and the clutch lever. Press the cannon pinion into place. Put on the minute wheel and setting wheel. These are idler wheels and must not be oiled. Any slow-moving wheel that neither receives nor delivers power should not be oiled.

In answering a question asked after the last meeting, I say that rinsing and cleaning solutions in cans may dry up oil; however, the very minute presence of solder

flux in a gallon of rinse seems to me to be negligible. We have used all kinds of solutions not bought in tins, even pure "casing head," and found some oils dry up, no matter what precaution you take. Once we washed all the watches we cleaned one week in soap and hot water, brushed them thoroughly and rinsed in hot water until perfectly clean, then dried them in a dryer. No rinse was used. Our records show what happened to the different oils used on those watches. An oil sold at that time, called "1929" dried up in six months. An oil bought in a drug store was out two years, did not run off the jewels nor was it dried up.

We do not believe in panaceas, nor do we have any theories of our own. The only way to settle a question in your own mind, is to prove it for yourself.

Use dial washers only when it is necessary to steady a sloppy hour-wheel pipe; where there is a small second hand that might be stopped by the wobbling hour hand, or where there is excessive end-shake between the minute hand and hour hand. Remember we are always working to reduce friction wherever possible. If the dial holes do not line up with the pinions after the dial screws are tightened, locate the direction the dial should move and place the edge of the dial on the sharp edge of an anvil and tap the plate with a plastic, wood or rawhide hammer. It needs only a light tap. Put the hour hand on and test for freedom. It should move up and down freely. Put the minute hand in place. See that both hands clear each other and dial figures.

Place the movement in the holder and test for freedom of gears. We know now that if the escape wheel stops suddenly, something under the dial is wrong. Recently we found a burr on a setting wheel which stopped two watchmakers from making the watch keep good time. Their trouble was not testing for freedom and backlash, after the dial and hands were put in place.

Sometimes when the hour hand is pressed down, the pipe on the hour wheel will contract and tighten on the cannon pinion. Occasionally we find a watch that will run down and have a tendency to turn back, but will not backlash. There is an American watch factory that makes a perfect gear; in fact it is too perfect for a watch, for there is little or no tolerance between the teeth and pinions. Just as a matter of knowledge, we took the wheels out of one of those watches and polished some of the metal from between the teeth with a hair wheel and light abrasive, and we got all the backlash we wanted.

Let's assume that our watch is perfect to the escapement, and that we are trying for speed in our work, and accuracy in our tests. We know from experience that the escape wheel teeth must have a small amount of oil on them. Once we let a railroad watch go out, making sure that the owner would return with it in seven days. With no oil on the escape wheel teeth, it lost about one hundred and eighty degrees (180°). After we touched oil on the teeth it came back to 540°. It is not advisable to put oil on the pallet stones, as the balance wheel is traveling at its highest rate of speed when it hits the fork, and will drive the oil back over the fork.

One of the finest ways to oil the teeth is to give the crown a turn and hold a brass or gold oiler near enough for the teeth to pick up a very small amount. Putting a gob of oil on a few teeth is not good work. Do not put oil on the pallet pivots. It took me years to learn that. As we said, the balance wheel is traveling at its fastest rate when it hits the fork. The recoil knocks the escape wheel backward, then it comes forward to hit the impulse face of the stone. The fork then has to catch up to and hit the roller jewel and give impulse to the balance wheel. Oil seems to cushion the shock.

For your own information, the next time a watch comes in for cleaning that is sluggish in motion and has oil on the pallet lever, clean the lever and the jewels thoroughly and note the change in motion.

Very little end-shake to the pallet arbor is most important. One one-hundreth millimeter is sufficient, if you want to be technical and can measure that close. For a quick check to see if the pallet stones are set correctly, give a turn to the main-

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spring and take a pair of fine tweezers and move the guard pin to dead center, so you can see the balance jewel hole through the opening between the tweezer points, where you hold the pin. At this point, one of the escape wheel teeth will be resting on one of the stones. If it is the receiving stone, the tooth face will be exactly opposite the stone. If it is the let-off stone, the tooth will have crossed only one-third of the face.

Test both sides. If the fork is out of line or the guard pin bent to one side, then both stones will be to one side of their correct position. If one stone is correct and the other is not, correct the one that is out of position. Move the lever slowly to one side until the drop occurs, and note the amount of lock, then move the lever slowly up to the banking pin and note how much slide. Do not have excessive slide on either side.

Put the balance wheel, which has already been trued and poised, into place. Stop it with your finger and turn it slowly until one pallet stone just drops off a tooth and test with a fine broach for corner clearance. Do the same thing on the other stone and your watch is ready to put into its case.

The smartest man that ever lived once said, "Whatsoever thy hand findeth to do, do it with thy might." Another smart man after him said, "Study to show thyself approved, a workman that needeth not to be ashamed."

I am afraid that too many watch repairmen want to make their living the easy way. It can't be done. Only by what we have learned in the past do we understand the present. Only by what we learn now will we understand the future. Every tradesman should give some of his time to improvement.

* * *

*(Next month, Lecture No. 5—Adjusting a Railroad Watch.)*

---

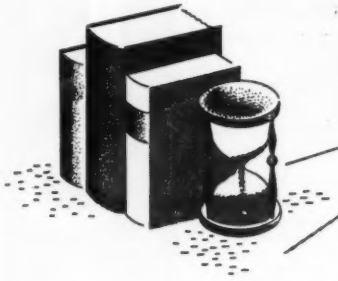
If you can't fix a man's watch, you can at least give him sympathy.

* * *

A lot of clerks couldn't make a living these days if they were paid for just what they know.

* * *

The one sure way to get an employe's head out of the clouds—is to put some responsibility on his shoulders!



# INFORMATION *Please*

**RM: I have an eight-day Seth Thomas mantel clock that gains a great deal of time. I cleaned it and put in a new escape wheel complete that had the same number of teeth as the original one. I have turned the regulator to slow and even put on a new pendulum wire, also let off some tension on the center pinion and it still gains. I shortened the verge wire to the same length as the old one without results — I even put on a heavier pendulum bob. What would you advise me to do to make this clock keep time, also what is the center of oscillation?**

Answer: With all the changes you have made I can only think of one thing that may be causing all the trouble. You say you put in a new escape wheel with the same number of teeth as the old one, however, may I suggest you check the number of leaves in the new pinion against the old. No doubt you will find that the new pinion has one leaf more, causing the train to run faster even though you used the same pendulum.

The center of oscillation is taken slightly below the point of suspension or at the point where the suspension spring flexes and from that point, the center of pendulum bob or mass of weight would be the point of oscillation.

**MY: A customer sent back a new watch to the shop where I work to have it adjusted. The watch is a 1361 AS automatic — it gains ten minutes every hour. I checked it for magnetism, but there was none present, the motion is very good — it doesn't seem to be hitting on the bridges and, in other words, everything seems to be in good order.**

**I also counted the teeth and leaves of the wheels against another watch of the same model, and they match evenly. I tried changing the balance wheel assembly, but the results are still the same, it still gains ten minutes every hour. I am at a loss to locate the trouble. Perhaps you can solve my problem.**

Answer: Your writer is at a loss to give any definite answer to your problem, however it may be possible that you made a mistake when counting the number of leaves in the escape pinion, which might have been put in before you received the watch, thus all of the confusion.

It is possible you have a 70-tooth fourth wheel with a 6 leaf pinion, so if the fourth wheel makes one revolution per minute the problem will be $\frac{70 \times 15 \times 2}{6} = 350$ vibrations of balance to one revolution of the fourth wheel, thus gaining 50 vibrations per minute and 60x50 vibrations would equal 3000 vibrations per hour. 3000 vibrations per hour divided by 5 would equal 600 seconds and 600 seconds divided by 60 would equal 10 minutes, which indicates that the probable reason is that your escape pinion has 6 leaves instead of 7.

**OEW: I recently purchased a lot of old**

**INFORMATION PLEASE**

**Directed by**
**W. H. SAMELIUS**

**Chairman, Science of Horology and Technical Advisory Board**

## UNCEASING IMPROVEMENTS

*Have made world-famous* **L & R** *chemical products supreme in their field.*

- L & R Extra Fine Watch Cleaning Solution.....Qts. **$1.50** • Gals. **$5.00**
- L & R #1 (foaming) Watch Cleaning Solution } .....Qts. **85¢**
- L & R #3 Watch Rinsing Solution } .....Gals. **$3.00**
- L & R Waterless Nofome #1 Watch Cleaning Solution } 5 Gal. Cans **$13.50**
- L & R Concentrate (foaming) Watch Cleaning Solution.....16 Fl. Ozs. **$2.00**
- L & R *Rapid Spread* Rust Remover.....**50¢**
- L & R *Plastic* Watch Crystal Cement.....Pin-Point Tube or Jar **35¢**
- Ellanar Silver Polish....Retail: 8 Ozs. **65¢** • 16 Ozs. **$1.00** • 32 Ozs. **$1.75**
- L & R Solderzit.....**50¢**
- Ellanar Jewelry Cleaner.....Retail Price: 8 Ozs. **50¢**
- Ellanar Jewelry Servicer.....Retail Price: 16 Ozs. **$1.00**
- Ellanar Dip—Instant Silver Cleaner.....Retail Price: 11 Fl. Ozs. **$1.00**

WATCHWORD OF THE WATCHMAKER

**L & R**

**material and find I have a great number of mainsprings without end fastenings. Thye are all coiled into a small ring and there is no indication as to what watch they were made for. I have tried to use some of them, but find they are all entirely too long.**
**They are of suitable strength and width, but what puzzles me is how can I tell how long the spring has to be to run a watch the required number of hours? They are all high-grade Swiss springs and I do not want to discard them. Any help you might offer will be appreciated.**

Answer: You have undoubtedly run across a stock of early Swiss mainsprings such as were used many years ago and left long purposely so that the workman could cut it to the proper length required according to the diameter of the barrel and the mainspring. To find the proper length of mainspring for any barrel to give the maximum number of turns possible, you can use the following formula: Square the radius of the inside of the barrel and multiply by 3.1416 — this will give the area; square the radius of the barrel arbor and multiply by 3.1416 — this will give the area of the arbor.

Subtract the area of the arbor from the area of the barrel, leaving area for spring and space, then divide the area by 2, divide that space by the thickness of the mainspring, and you will arrive at the proper length of spring employed in millimeters. Again divide by 25.4 and the result will be the length of the spring in inches.

**FJD: I have been told our modern electric house clocks keep perfect time. I have one in the store that I use for a regulator to regulate the watches with, and I get quite confused as sometimes my watches are right on time to the second for an hour or so and then suddenly there will be many seconds variation in time either fast or slow. Can it be the fault of my work? How close should an electric clock keep time?**

Answer: All electric clocks are controlled by the powerhouse generators that are governed to give 60 cycles per second, however, if the generator speed changes, so will the cycles. Some stations have master clocks to control the generator speed, consequently the cycles will be quite constant, and if your clock shows a variation of time, it is not the fault of the clock, but the fault of your station. However, all stations do not have the complicated system of controlling cycles and depend on the engineer to check the speed of the generators by means of recording instruments.

As a rule, the engineer checks each hour to either speed up or slow the generator, and it is during this interval of time that your clock falls behind or gains time. It is to the company's interest to maintain as even as possible a constant speed and thus not waste power by using more or less coal than is necessary to maintain a 60-cycle current.

**JP Jr: I have a small shop and do have watches come in for repairs that call for new jewels. I find I have trouble determining just the right diameter of jewels to use, as I have no way to check the hole diameter at the present time.**
**I cannot afford a friction jeweling outfit and only have an assortment of friction jewels. The only way I have to press the jewels to place is by means of the staking set, so quite often I have the hard luck to crack or crush a jewel. Can you suggest some easier way to gauge the diameter of the hole so I may select a jewel that will fit friction tight without breaking? I do have a ½" metric micrometer.**

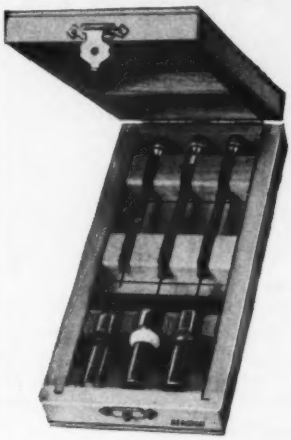
Answer: Since you do not possess a friction jeweling tool complete with all plug gauges for determining hole sizes, may I suggest you turn a brass or steel plug that just fits the hole and then, by means of your micrometer, gauge the plug. Then you can select a jewel by micrometer reading about .02mm larger than the plug gauge.

If you are fitting small jewels you will find .01mm will be large enough to create a safe friction fit. You might also use a round burnish broach, insert it in the hole and note or mark just where the broach stops, then by using the micrometer you can take a reading from the round broach and select a jewel to fit.

## CORRECTION

**Prices of the watch cleaning machines featured on page 23 in the November advertisement of the L & R Manufacturing Company were incorrectly listed. Prices should read as follows: L & R Master, $76.50, instead of $69.50; L & R Mastermatic $92.50, instead of $84.50; L & R Heavy Duty $112.50, instead of $99.50; L & R Automatic $274.50, instead of $249.50.**

## BERGEON SCREWDRIVER SETS



**Bergeon screwdriver sets are the finest watchmakers' screwdrivers available. All sizes are made of chrome steel with color identifying bands for easy selection. Each screwdriver has its companion tube for spare blades. Set in a handsome polished hardwood box.**

| | |
|---|---|
| **Set No. 2639**—Set of 5; Sizes .50 - .60 - .80 - 1.00 - 1.20 mm | **$11.20** |
| **Set No. 2631**—Set of 3; Sizes .50 - .60 - .80 mm | **7.55** |
| Individual sizes with tube of 5 extra blades, state size, each | **1.70** |

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**B. JADOW, INC.** **NEW YORK, N.Y.**


**HLT: I have a balance staff on a 992-B Hamilton watch. The question I have concerns the pivots on the staff. The staff is new except that the upper pivot has been slightly altered by myself, and my question is are the pivots supposed to be rounded as the untouched pivots are, or is the one I have re-shaped more nearly correct? I have been taught that the pivots should be flat on the bottom with slightly rounded corners — I have tried both shapes in position adjusting the 992-B Hamilton and have had better results with my slightly flattened pivots. Please explain the staff for me and give your opinion.**

Answer: Your writer cannot lay down any fixed rule as to the proper shape of end of balance pivots. Our American watch manufacturers use flat end pivots for railroad watches, having the corner very slightly relieved then the watch is tested for position rates and to make necessary changes so as to bring the pendant and dial rates equal.

There can be several reasons causing unequal rates, such as thick or thin balance hole jewels, even if olive hole jewels are employed as the bearing surfaces do vary. The cap jewels may not be set perfectly flat, causing a fast rate, the pivot diameters not alike, hairspring not perfectly centered or true on the collet, ends of both pivots not exactly alike. Summing up your question, it really boils down from actual experience what changes to make when altering the balance pivot, whether it should be round or flat.

A round end pivot will invariably show a slow rate as compared to a flat end pivot, a large diameter pivot will show a faster rate in pendant position than a small pivot will, so the watch factories start out with a flat end pivot, check the rate of their watch in the dial and pendant positions and then make the necessary changes, which may be any one mentioned before. It will really be up to you to determine just what changes are necessary for the individual watch you are adjusting.

**GB: Should the center sweep pinion be oiled or left dry?**

Answer: The general rule is to lubricate

the bearings for a pinion that has direct drive. For a follower pinion, omit the oil.

**HMCK: I am wondering why the watch companies don't make the two pallet stones alike and save us watchmakers a lot of headaches. As it is now, the stones are very near alike, but still if one does not find the right place for them, he cannot get the escapement to function properly. If the stones were alike and interchangeable, a lot of our troubles would cease.**

Answer: Your suggestion has been studied and much research work done along that line, but so far nothing practical has been developed, as pallets made duplicate and interchangeable involved very much distorted pallet frame and unequal leverage. Our escapements today are practical and easily adjusted when thoroughly understood.

**ID: I am disabled and must use a wheel chair to go about and naturally, I cannot, or might say, find work to support myself. A friend suggested that I take up watchmaking and by that means I could sit at a bench and feel sure, by thorough training in this trade, I would be able to make a living and become self-supporting. Any information will be appreciated.**

Answer: To become a good watchmaker takes a great deal of patience and practice. You should have good eyesight, not of a nervous disposition, mechanically inclined and of average education. I know of several wheel chair cases where the student has made good and is now running his own repair shop, and I see no reason why you cannot do the work just as well as the able-bodied man.

Of course, the able-bodied man has an advantage, being able to get around the store and wait on customers, but even at that, I know the cases I speak of do have their own stores and sell merchandise. There are several schools you can attend but through correspondence you can learn if these schools can accomodate you. Among the schools which have long established records are: Elgin Watchmakers College, Elgin, Illinois; Bowman Technical School, Lancaster, Pennsylvania; Bradley Polytechnic Institute, Peoria, Illinois, and the American Academy, Inc., 1901 Colfax Avenue, Denver 6, Colorado.

**HRA: Please advise of a good method for removing mercury from a yellow gold band ring.**

Answer: Heating the ring over an alcohol lamp will cause the mercury to evaporate —you can then polish the ring.

**KH: I want to build a regulator clock with a seconds beat pendulum. Where can I obtain complete drawings of such a clock or must I have a set made up by a draftsman?**

**I have a bench lathe with all attachments and have been cutting wheels and pinions very successfully so I feel confident I can build a clock if drawings and specifications are available.**

Answer: You can procure complete drawings for a metal or plastic clock having a seconds beat pendulum by writing to the American Horologist & Jeweler Book Department, Box 7127, Capitol Hill Station, Denver 6, Colorado.

**TEW: I have a repair shop at a summer resort and quite often I take in a watch that has been dropped or immersed in salt water and, naturally, it is rusty. Is there a way to clean such a watch and prevent it from rusting after being cleaned?**

Answer: From a bulletin issued by the Canadian Jewelers Institute, I am taking the liberty of quoting an article which may be helpful to you and many of our readers. "A watchmaker located in Cape Cod has done some special research in dealing with watches that have been dropped in salt water. Water is a bad thing for a watch movement, but salt water is very much worse. Apparently it is widely believed by many laymen that the best thing to do is to immediately immerse a watch in kerosene when it has been exposed to salt water. This watchmaker states, "The best which can be expected from dipping a salt water-soaked watch into kerosene or gasoline is an emulsion and this means that salt will deposit liberally throughout the movement no matter how much volatile fluid is applied." Even if the movement appears to clean out satisfactorily, the chances are that it will clog up with rust within three days. In the course of this research, this watchmaker first dipped a lady's watch into a bucket of sea water. It was then exposed to the air for the average amount of time it would require to transfer it from the beach (where the accident hap-

# FINE WATCH SPECIALS

| Chronograph | Waterproof | Automatic Waterproof | Nurses' Waterproof |
|---|---|---|---|
| 17J Chrome top/SB | 17J Chrome top/SB | 17J Chrome top/SB | 17J Chrome top/SB |
| $16.00 | $10.25 | $15.50 | $13.00 |
| | In All Steel | In All Steel | Yellow top/SB |
| | $13.00 | $18.50 | $15.00 |

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**HENRY SOBEL & CO., INC.**

**145 Canal Street** • **New York, N. Y.**


pened) to the jewelry store. Within this space of time, the untreated watch which was allowed to dry out, was packed solid with rust and incapable of being repaired. The second test was to drop another watch into sea water, then rushing it into the standard cleaning solution and centrifuge. It was first thought that this had achieved results, but at the end of the following day, this watch was also filled with rust as latent chloride salts undisturbed by the cleaning solution asserted itself and began a growing action on the polished metal surfaces.

The test which finally proved effective was to immediately immerse the sea water-exposed movement in ordinary fresh water. The watch was thoroughly flushed with fresh water and transferred to the repair department in a glass of fresh water.

This proved the solution to the chloride salts problem because the fresh water is capable of dissolving the tiniest quantity of salt hidden in a bearing, behind a supporting post and so on. When the watch was removed from the fresh water and placed in the cleaning solvent, it cleaned out well and could be dried with no fear of rusting. This watchmaker now always recommends to customers that, should their watch fall into sea water, that they put it at once into a container of fresh water and take it to the watchmaker as soon as possible."

**OLH: I have in for repairs a 992-B Hamilton watch in a gold-filled case, screw back and bezel. I cannot remove the back — it will turn just a little and then stop. I notice when I turn the back a little it will turn the movement, so I suppose the case screws, one of them has become loose and is jamming the back. I cannot force the back off and this watch will have to be opened.**
**I get rusty watches in for repair — what is the best method for removing rust from the small pinions such as the train wheels, clutch and winding parts?**

Answer: Remove the front bezel so that the movement will partially drop out. It is possible that the movement screw will also drop with the movement, allowing the removal of the back cap. If not, you may have to use force enough to break the movement screw, or pry the back cap off by jumping a thread.

After the cap has been pried off it will be an easy matter to remove the movement; the damaged threads to the case center may be re-shaped with a fine 3-square file and if the threads are dam-

aged in the cap, a v-shaped scraper may be used to restore the damaged threads.

To remove rust from steel pinions shape a piece of hard pegwood to fit between the leaves of your pinion, use very fine flour of oilstone powder and oil and rub lengthwise with the leaves removing the rust. Follow up with a fresh piece of pegwood charged with diamontine and oil to obtain a high gloss.

A small round bristle brush about one inch in diameter mounted in your lathe can be used on steel parts for removing rust. Charge the bristle brush with fine oilstone powder and oil, and when using the brush, run it at high speed.

**JHP: I have a ¾ plate 18S Bristol watch, key wind, no number on the plates. The staff and jewels are broken. Where can I obtain material for this watch?**

Answer: The Bristol watch was made in Switzerland and imported by importers carrying on business in this country under the name of the Bristol Watch Company, some 50 or 60 years ago. At the present time, material for this watch is not available and would have to be made to order. May I suggest you send the watch to some of the repair shops advertising under the heading of "Service & Trade Work" in the American Horologist & Jeweler.

**SP: Can you give me some information on where I can have parts made or bought for cylinder watches?**

Answer: Cylinder escapement watches have been discontinued for many years and as far as your writer knows, it is possible that you may obtain blank cylinders that you will have to pivot and turn the balance hub to fit the balance wheel.

If you are not in a position to do this work yourself, may I refer you to the above answer to JHP.

**PBP: I have a problem. When taking apart an Incabloc equipped watch, I often find that either, and sometimes both, balance pivots are worn down to just a nubbin as if they were, or had been, running in grinding compound. Several watches that I have found this way were ones that I had sold myself and came back for regulation or cleaning. Usually it takes about a year or year and one-half to wear out the pivots. Could this condition be caused by grinding compound left on the pivots or in the hole jewels at the factory, or is it caused by rough jewels?**

**I have had to restaff several watches and have one on my bench right now that has both pivots worn out. Usually I change the jewels to be sure the same thing doesn't happen again. Should such watches be returned to the wholesale house — most of these have been brand name watches.**

**It is kind of tough to convince a customer that his watch needs a new staff and jewels besides cleaning after only a year of service, especially when one has sold him on the idea of a shock-protected and water-protected watch. I feel I am having this trouble and that lots of other watchmakers are, too, and also feel that we are taking a beating from someone, either the wholesale house or the manufacturer of the Incabloc jewels.**

**I don't have a microscope to examine the jewels; they look all right after cleaning through a seven-power loupe, but I am convinced that they are rough or grinding compound has been left on them at the factory. Would appreciate your comments on this.**

Answer: Your writer is hardly in a position to commit himself just what the trouble or troubles might be, but would be happy to have some of our readers who may have had the same experience to write this department, a letter explaining what experience they have had along these lines. All letters will be published in a later issue.

* * *

**Mrs. Samelius and myself wish to express our Christmas greetings to our readers, friends, and former students of the Elgin Watchmakers College.**

**W. H. Samelius**
**Hotel Mayfair**
**Third & Garey**
**Pomona, Calif.**

# *Watchmaker's Contest*

A.H.&J. Reader Ideas on Practical Bench Methods, Experiences or Tools.

**A.H.&J. is pleased to announce the following winners of its November Watchmakers' Contest:**

**Firse prize: M. J. L. Fitrite Asst. No. 178A Chronograph Staffs, to Mr. Fred Ammann, 275 West Thornton Street at Canal Bridge, Akron 7, Ohio, for his "Holding Clock Arbors to Polish Pivots," Contest Entry No. 37.**

**Second prize: M. J. L. Balance Truing and Poising Caliper, to Mr. Mark L. Davenport, 7415 Garden Grove Avenue, Reseda, California, for his "Dust Seal," Contest Entry No. 42.**

**Third prize: Algren Pat. Springs Bars, 72 Asst. Sizes, to Mr. Winfred Linder, 129 North Church Street, Spartanburg, South Carolina, for his "Gaskets for Waterproof Watches," Contest Entry No. 39.**

## MAKING USE OF RIVETS

CONTEST ENTRY #44

Many times in knocking out a balance staff, the rivet is removed as a small perfect little ring. I make it a habit to save these for many uses. Placing one on a click screw will free a tight click. Timing washers are too big.

I have placed one between roller and hub of a balance staff rather than bend a fork. Often they are just the size washer needed.

## CHECKING SAFETY ACTION EASIER

CONTEST ENTRY #45

To simplify matters in checking the safety action between the roller table and the guard pin and also between the roller jewel and fork horns, let the mainspring clear down, and then still holding the click, turn the mainspring barrel backward a few teeth.

This will reverse the train and the teeth of the escape wheel being in contact with the let-off side of the pallet stones will hold the lever against the roller table or roller jewel so that it does not need to be pushed over against them to check the safety action.

## PREVENTING WATCHES STEAMING UP

CONTEST ENTRY #46

If you have trouble with your customers watches steaming up, you can get a preparation from your drugstore that is used to rub on eye glasses to keep them from steaming up in the winter.

Just coat the underside of the watch crystal and it will not steam up as long as water does not get into the watch.

## SIMPLE BENCH TOOL TIDY

CONTEST ENTRY #47

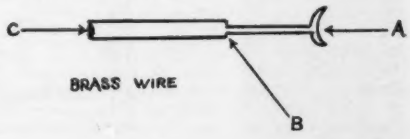
A very simple bench tool tidy for watch screwdrivers, oilers, pin vises, tweezers, etc., can be easily and quickly made from waste material as follows:

Obtain a piece of corrugated package wrapping which has not been damaged in transit and cut to a size approximately 3" wide and between 9" and 12" long. Stick this onto a cardboard base of the same dimensions and from 1/16" to 1/8" thick. Brush on some shellac, similar to french polish, which will be readily absorbed, and when dry the unit will be found to have hardened and to be quite strong. A coat of enamel or paint can then be applied if desired.

Site at the head of bench plate with your small tools arrayed thereon to suit. When not actually in use the tools are always at your fingertips and each one in a separate compartment. For storing gravers, two layers made up similarly and of suitable dimensions can be fitted into a shallow cardboard box and one layer kept for sharpened and the other for dull gravers.

## REPLACING A DIAL FOOT

CONTEST ENTRY #48



**WATCHMAKERS' CONTEST—Continued**

Here is my entry for the Watchmakers' Contest. In order to replace a dial foot, cut a brass wire in your lathe to the shape shown in the drawing, then take a fine-tipped soldering iron and file the end of your tip even smaller so it will give less heat.

Dip the hollow end A of the wire in flux and fill it with regular soft solder. Scrape the dial with a graver, leaving it a bit rough; place wire on dial with A hollow over the correct clean position and apply soldering iron on top of A until solder flows. The wire should be held upright with a pair of heavy tweezers.

Cut at B and file to the desired length. This method will work when others fail, and soft solder is stronger than bismuth.

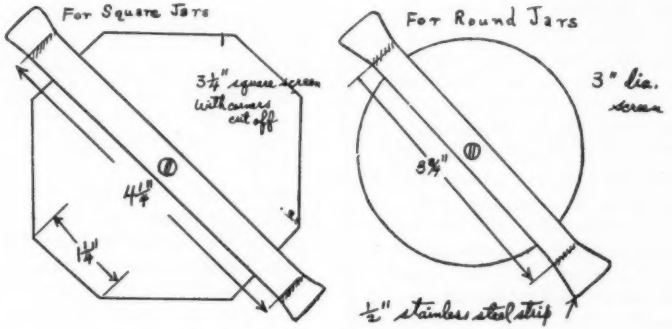
## FILTER TO ELIMINATE LINT AND DUST

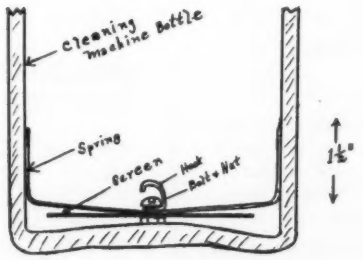
CONTEST ENTRY #49

While touring a dry cleaning plant last year, I noticed that they used a monel filter which changed the dirty brown cleaning solution to a crystal clear solution ready to be used again. This gave me the idea that a similar filter might be used right in the watch cleaning machine bottles to eliminate the lint and fine dirt that continually circulate through a watch being cleaned and stick in the basket and watch parts.

Experiments showed that regardless of which direction the basket rotates in round or square jars, the fluid circulates down the sides and is drawn up the center of the bottle with considerable force. A fine monel mesh screen held on the bottom of the jar without fitting closely to the edge or the bottom of the bottle traps all loose dirt underneath it.

A firmless stainless steel spring is necessary to hold the screen down against the flow of the liquid. A hook in the center permits the screen to be raised easily with a piece of wire to look for tiny parts that occasionally escape from the cleaning basket. I have used 80x80 monel mesh and 24x110 stainless steel screen with equal success, and one filter should be used in each bottle and will eliminate every trace of loose dirt. The filters will last a lifetime and are easily cleaned when the solutions are changed.



# CLOCKWISE...*and*...OTHERWISE

By J. E. COLEMAN

## OTHERWISE

Answer to October "What's Zit." The J. P. Stevens Watch Company of Atlanta, Georgia, about 1884.

* * *

A new tool. At the very outset allow me to make it clear that the question, to disassemble or not to disassemble, is not being considered here at all. John W. Fisher, P. O. Box 325, Prairie du Sac, Wisconsin, had come up with a tool for rebushing clocks without disassembling the movement, $29.50 direct from him. However, in his last letter he wrote: "I hope to have these available at all dealers through a national distributor soon. Pending arrangements, I will fill orders in rotation from here."

At first thought we just said it could not be done—properly. Then Mr. Fisher described the operation and we came up with the argument that even if he did have a cutter and press for drilling the plate and pressing in new bushing "what about the scored pivot"? Promptly he came back with the answer that once the plate has been drilled, that arbor can be raised through the enlarged hole, taken out and either be polished or re-pivoted in the lathe, the new bushing correctly fitted to the pivot while both are free in your hands then the arbor set back (again via the enlarged hole) and then the bushing pressed home.

He sent down one of the kits. It consists of an end cutting mill, centers of three sizes to fit in this mill, a supply of assorted hole size bushings and a hand lever press. To re-bush a worn plate bearing,

"When's It"

you place the mill in the lathe, select a pilot center that fits the pivot and insert it, bring the clock up holding it perpendicular and run the mill at a fairly fast speed centering the operation with the pivot in the pilot hole.

After the hole is drilled in to the clock's plate, remove the brass that will remain on the pivot. If the pivot is scored or needs polishing, lift it out through the enlarged hole and complete that operation,

Mr. Coleman invites your questions. If your question requires a direct answer, please enclose a self-addressed, stamped envelope. It is impossible through correspondence to give valuations of antique timepieces; questions of this nature cannot be answered

then select a new bushing whose center hole is slightly smaller and broach it to correct size. Set the arbor in place and push the new bushing into place with the bushing presser. Job finished. All new bushings are of the same outside diameter, thus only one drill and all fit correctly.

Mr. Fisher further points out that he is going to include male centers (or put a male end on the back of the female centers) and that where the clockmaker wishes to take the movement apart, he simply uses the male pilot for centering the hold in the plate when drilling and that his tool is one of the most efficient and practical ones to be had in that price range regardless of whether you take 'em apart or not. He further states that there will always be available for re-order, all parts of the press, bushings, drills and centers.

* * *

Clark Seymour, clockmaker of Palestine, Illinois, would like to have the correct address of the manufacturer of a school program clock marked "Standard Electric Time Company". We've searched through the new Jewelers' Buyers Guide and other listings and do not find it. If any reader has this address, won't you please send a postcard?

* * *

Michael Kahane, watchmaker of 350 Lefferts Avenue, Brooklyn 25, New, York, sends a nice letter regarding his enjoyment of the column and says that he is again opening up his bezel-making service and is now able to handle, on a limited basis bezel replacements of round style only in gold, silver, gold-plated or stainless steel, and soon will be making entire new cases to order as before when he closed to do war work.

* * *

Several columns back, Herman H. Seff, 112 East Main Street, Columbus 15, Ohio, had an inquiry re the Vermont Clock Company of Fair Haven, Vermont. It was not listed, but Edwin B. Burt (Auburndale 66, Massachusetts) and Walter E. Mutz, (Chelsea Clock Company) came to our rescue, and Mr. Mutz included a photo of the factory with his information.

Recently we located practically the same query in one of the trade journals for January, 1923. Since it was not listed and this answer was given by a former employee of that company, we quote it here and send a copy to Mr. Seff: Clayton W. Parker of Fair Haven, says: "I do not know as I can give you very much information as they have been out of business for some time. They only operated for a few years and this was approximately twenty-five years ago.

"The stock was largely owned by Fair Haven people—I think the practical superintendent was a man by the name of Pidgeon, but do not remember where he came from, possibly from the old Boston Clock Factory which I think was taken over as a starter for our company. Very likely this is where the idea of making the clock with three plates came from, as the Boston Clock Company made them that way and it was a fine clock.

"The Vermont Company made a great variety of clocks including wall clocks, ship's bells, traveling clocks, crystal time and with strike both in pendulum and 7-jewel levers, in fact, too great a variety for a young company with limited capital and they became financially embarrassed and had to close down.

"You must remember that this was a young company and did not run long enough to get into their stride, and when I worked on some of the early models of some of our most noted watch companies and saw what terrible struggles some of their designers have had with simple mechanical problems, I feel that there are others who have also had the same disease.

"In their first mantel clocks they used a 7-jewel lever escapement bought from the Waltham Watch Company and these clocks were very satisfactory. The writer has one of these running in his home, also one of the 7-jewel traveling style and both are giving perfect satisfaction—they were marketed at a small fraction of what similar clocks can be bought for today.

"Later the company made their own escapements and many of these were not as good."

The editor adds this observation of his own: "Evidently the Vermont Clock Company planned a line of mechanical excellence in clocks that had as its base a long run with one winding. They took their plan from an eight-day chronometer, that

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is, a long and big mainspring, which called for another plate for room and strength. They would have done better with two smaller mainsprings and put in an extra train wheel for the long run."

* * *

As we come to this last *Otherwise* for 1954, we cannot help but reflect on how much and how well the clock repair industry has progressed during the year. There has been a number of new tools, a number of new books, and practically all were dealt with at length month by month as they came out.

The material and parts situation has eased up a bit as is to be expected in peacetime years. From our viewpoint, cooperation—that which we've advocated and pleaded for — is steadily marching forward. One of the outstanding examples (and we could mention several) was Charles Terwilliger's "Horolovar 400-day Clock Repair Guide" (#B288, A.H.&J. Book Department, $3.00 plus 10c postage.)

One reliable authority recently estimated that there are two million 400-day clocks in circulation in the U.S. today. These pieces, of slightly different construction, present a problem for our new generation of repairmen not familiar with them. The Terwilliger book graphically demonstrates the ability of the trade to meet and take care of new demands on it.

A healthy, progressive trade ought to serve as a challenge to the individual mechanic to avail himself of every opportunity of increasing his knowledge and skill. We often wonder, after talking with one of those "S.J.&.C. horologists" (the s, j, and c stand for staff, jewel and clean), whether or not his abilities and knowledge even cover those three items, for he certainly never intimates that it extends beyond them.

* * *

Again back to the industry. The United Horological Association of America, as a part of it, offers to the individual mechanic many opportunities for improving his knowledge and skill. Further, the Association maintains an excellent laboratory and supervises practical examinations through which a watchmaker may obtain a certificate of proficiency. I have yet to see a man with an earned degree who was not very proud of it.

Let's have a look at what the horologist of several years back went up against to get his certificate: In an issue of the British Horological Journal for 1884, we find where the B.H.I. set forth the requirements for a second class certificate as follows: "A second class certificate will be awarded at the expiration of one year or more to the student who shall produce without assistance and without instructions, a three-quarter plate ordinary escapement, also a three-quarter plate finishing, sufficiently perfect and well finished as to be a creditable piece of workmanship. He shall also produce a good mechanical drawing of some portion of a watch or clock and shall pass an examination in the theory of horology, such as in the opinion of the judges shall entitle him to a second class certificate."

A detailed account of one of these examinations is found in an early 1886 issue; the questions covering the theory portion of the examination were: "1. Define friction, specific gravity, lifting angle, dead beat; 2. A given mass exactly balances a pound of weight when weighed at the North Pole in a pair of scales and indicates the same weight in a spring balance. When transferred to the equator, the scales indicate the same weight as before, but the spring balances do not, why? 3. Is the motion of a pendulum uniform or variable throughout its oscillation? Give reason for your answer.

"4. How would you draw the teeth and leaves for a wheel of 80 driving a pinion of 12? 5. How is more or less uniform motive force secured in (a) good going barrel watch? (b) a fusee watch, and (c) a weight clock? 6. A watch beating 16,200 vibrations per hour loses 144 seconds per hour with the following train: Center wheel 80 teeth, third wheel 75, pinion 10 leaves, fourth wheel 75, pinion 10 leaves, escape 15, 8 leaves. What change would be required to bring the watch to time without altering the number of vibrations?

"7. What is the cause of shifting of the hands often observed in keyless watches when the push piece moves in or out? State how it may be prevented. 8. How woud you fix a mainspring hook? 9. Ex-

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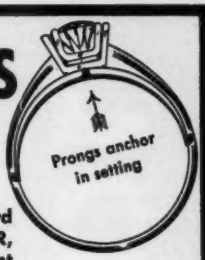


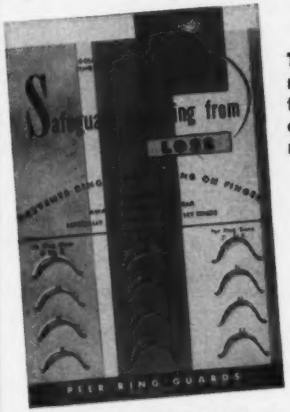


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plain clearly how you would tell whether a fusee is cut to correspond to a given mainspring. 10. Describe with the aid of a sketch any form of gauge capable of measuring length to within 1/1000 of an inch. 11. Explain generally the mode in which it has been recently proposed to introduce a universal system of time."

At the time these questions were used (1886), F. J. Britten, whom we should all know through his book, "Old Clocks and Watches and Their Makers" and "The Watch & Clockmaker's Handbook", was secretary of the B.H.I. On the committee handling the theory portion of the exam was T. D. Wright, whose great treatise is now being reprinted each month in this magazine — "Technical Horology," and on the committee for the practical work portion was Victor Kullberg, famous chronometer maker of 105 Liverpool Road, London. Other committee members were equally qualified, if not so well known at this late date. The theory committee was composed of three members and the practical work committee had five members.

It is interesting to push this observation just a step further — the candidate making the highest grade in this exam, 75 was passing, but we are not told his mark, only that it was highest and he was awarded a bronze medal, was B. Bonniksen, who was later to invent the Karrusel watch and get the approval of the U.S. Navy on it. How about it? Could you do 75 to the satisfaction of the judges like that?

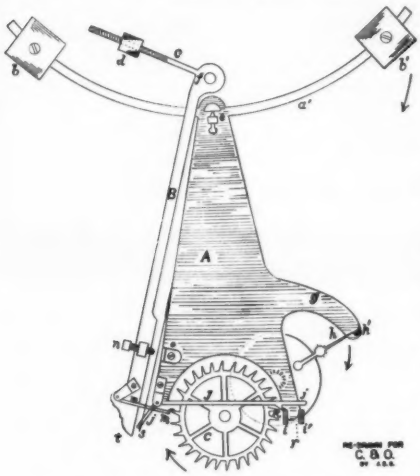
* * *

This about cleans up the year 1954 except for some outside mail. From time to time we receive nice letters lightly commenting on the column and sometimes suggesting certain things to be mentioned or covered. If there is an indication that they are not to be directly in a forthcoming column, we just call them "outside" mail, meaning outside the regular *Otherwise* chit-chat. Some of these are answered directly (when we can get to them), but all are carefully kept to see if they indicate a trend.

One of these outside letters suggested more clocks to make, stating that the suggestion of several months back of a method of converting an ordinary 8-day movement into a ship's bell striker was by far

the best thing carried by the column. Several others mention "odd" escapements.

Making a clock from "scratch" is one thing — re-working over an old movement can be almost as much fun and will probably be tried out by a greater number of clockmakers. Recently we ran across an odd escapement, gravity, which looks as if it would be easily constructed and attached to an already existing train, plates, etc., in the American Horological Journal for November, 1871 and re-sketched the drawing and quote the following:



"Nothwithstanding the great variety of forms which have been given to the gravity escapement since the days of Hardy and Berthoud, the changes seem by no means exhausted. The principal of using a constant weight to drive a pendulum, independent of the train and thereby eliminating the errors incident to the construction of wheel work is so attractive in itself that it has engaged the attention of many of the scientific men of our age, for whom an ordinary mechanism would have no charm.

"During a recent visit to New Hampshire, I saw running at the observatory of Dartmouth College, a clock with a gravity escapement, the invention of Prof. Charles A. Young, whose name is prominently connected with many of the recently spectroscopic discoveries relating to the constitution of the sun.

"The clock has performed remarkably well under severe scrutiny, although the wheel work is only that of an ordinary old-fashioned 8-day clock and the workmanship of the escapement itself by no means unexceptionable. Because it is in actual operation and not merely a design, I thought it would be of interest to our readers and so have prepared a drawing and a description of it.

"It must be premised that the impulse is given to the pendulum in only one direction, which Prof. Young, as well as Bond, Airy and other high authorities consider of no practical consequence, and also that the clock has an excellent gridiron pendulum.

"In principal, the escapement is identical with that of Kater and is closely analogous to others invented by Bond and by Tiede, but differs from them all in requiring no special accuracy of construction to secure its perfect performance.

"The escape wheel C is the same which belonged with the dead-beat escapement with which the clock was originally constructed. A is the locking arm, having at its upper part two horns a and a′ in on which slide weights b and b′ admitting of adjustment so as to put the system consisting of the arms A a a′ in equilibrium around the conical points e on which it turns with a slight preponderance to b′ in the direction shown by the arrow. The whole system is somewhat heavy so as to have considerable inertia, an essential quality in this type of escapement.

"The arm A also has on the right side as arm g, which carries at its outer end the locking jewel h′ and the check h. The lower end of the arm A is forked and the right hand end carries the pin r, which plays between two stops i and i′ which are attached to the front plate of the clock and serve to limit the motion of the arm.

"The left hand end of the arm carries a delicate bent lever j, j, j, about as light as an ordinary sewing needle and which Prof. Young calls a "trip guard". This lever has near its right hand end a tooth k, which when the arm A is in locking position, drops behind the stop i and prevents the arm from being displaced either by an irregular force in the train

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or by any sudden jar from without. At the lower left hand extremity this lever is bent towards the spectator in such a way that it may be struck by the arm B. This movement raises the other end lever and throws the tooth k clear of the stop i, leaving the arm A free to move.

"A little behind the locking pin lies the impulse arm B and attached to the same axis f is an arm on which is an adjustable weight d for varying the impulse given to the pendulum. There is also another arm lying behind B and parallel with it, which acts on the pendulum in the manner usual in this class of escapements. The arm B has near its lower end a screw n for acting on the stop o, on the arm A and still lower down it has a lever m, m by which the escape wheel is enabled to lift the arm with little or no friction, as Harrison gave the impulse in his escapement.

"To diminish the friction of unlocking, the wheel C is connected to a train of two wheels, the last of which makes one revolution for every tooth of the escape wheel. The last axis of this train carries a poised pin q, the long end of which is bent backwards at right angle and engages the locking jewel h. So much by way of explanation, now for the action.

"Suppose the parts to be in the position shown in the figure, the pin q locked by the arm A, through the instrumentality of the jewel h, the arm itself held in position by its preponderance and protected by disturbance by the trip guard j, j and the impulse arm B raised and held in position by the escape wheel C.

"The pendulum swinging toward the left, raises the arm B until the forked end of the lever m drops off the point of the supporting tooth of the escape wheel and rests on the pin v. Having completed its excursion to the left, the pendulum, in returning, carries the arm with it until the lower end t touches the tail of the trip guard j, j, lifts it clear from the stop i.

"Immediately after, the screw n, striking the stop o, meets the resistance due to the inertia of the arm A and its attached weights. This momentarily checks the motion of the impulse arm and allows the pendulum to leave it, after which the weight of B, acting upon A, moves it toward the left. Unlocking the pin q allows the escape wheel to turn, then the

tooth, catching the end of the lever m, lifts the impulse arm B, and the locking arm A relieved of the extra weight, resumes its original position, the tripping guard drops into place and all is ready for another movement.

"Were it not for the trip guard, which is really the characteristic feature of the invention, it would be exceedingly difficult to prevent pin r from rebounding from the stop i, and thus unlock a second tooth. Such is the action of the escapement, which may at first sight appear a little complex, but whose certainty of action and ease of construction leave nothing to be desired.

"It will, of course, be noticed that in constructing this escapement with new materials, it might be considerably simplified as by putting the escape wheel and arms outside of the plate, and by giving three or five teeth to the escape wheel. Being constructed with the movement of an old clock, the garment had to be cut according to the cloth.

"As will be noticed, the impulse arm is utterly independent of the train, while the pendulum is in contact with it, and it is only after the pendulum has left it that the unlocking takes place, consequently no imperfection of the train or variation of driving power can by any possible way affect the pendulum."

(Signed) ALFRED BLAISDELL,
BROOKLYN, N.Y.

We intend to have a try at one if and when we can possibly get a little time in the not-too-distant future. There is a slight resemblance to John Harrison's "grasshopper" escapement and we are anxious to see it work.

* * *

About the time your postman delivers this he will also be bringing Christmas cards. Jan and I can't send each of you individually a card, so we take this opportunity to wish each and every one of you the merriest of Christmases.

One thing that gives us real Christmas joy is the fact that you readers have been so kind with your cards, notes, etc., throughout the year. When we stop to realize that we are utter strangers just coming into your homes via the American Horologist & Jeweler every month, then see how very kind you have been to us, it makes us want to say as the apostle Luke did 2,000 years ago: "Glory to God in the highest, and on earth peace, goodwill toward men."

JAN AND JESSE

## CLOCKWISE

*Dear Mr. Coleman:*

*Needless to say that I, like a great many other people, find your column both enjoyable as well as instructive. I have taken the American Horologist & Jeweler for many years, in fact I am listed with the U.H.A.A. as member at large No. 80. I now have a repair shop and am specializing in the repairing and rebuilding of all makes and kinds of clocks. I am doing trade work for the other jewelry stores as well as the work that I take in at the retail level, and hope some day to have a large enough volume so that I can do clock work exclusively.*

*I have one or two problems on which I need help; first, I have a French marble case clock for repair similar to the one in the photo I am sending along to you. This clock was pushed off of a table and the case broken all to pieces—I don't mean that the marble was broken, but rather the case came all to pieces at the joints where it was cemented together. I thought that maybe you might know of a cement that could be used in putting this case back together. I have tried several cements, but none have worked. Better still, maybe you know of someone to whom I might send the case and have it reassembled.*

*Second, I have a French movement for which I need a new escape wheel and verge. The movement is 3¾ inches in diameter and 1⅛ inches in between the plates, and stamped in a circle on the back plate is the following: "Medaille d'Argent L Marti et Cie 1889"; the following number is stamped on the back plate: "1299 3 9." Is it possible to order these parts, or do they have to be made specially? If they can be ordered, from whom would I order them, and if they have to be made specially, your suggestions as to where to send them would be appreciated.*

EDWARD U. TSCHABOLD
*611 Scott Street*
*Wichita Falls, Texas*

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Dear Mr. Tschabold:

I appreciate your kind remarks about our efforts. As to the numbering of membership cards, I'd never thought to check on it. I, too, hold a member-at-large card and it is numbered 2. Perhaps they have separate numberings for each state and I just happened to catch the No. 2 for my state. On the other hand, everything in Texas has to be so much larger, so it's no wonder your number is larger than mine.

Properly packed for shipping, one of those marble cases is quite a job by itself, to say nothing of the express charges, or the risk that it could be jolted apart coming back to you. I'd never think of shipping one just for a cement job. We are told that the old marble case makers used a cement composed of Russian tallow, brick dust and resin melted together, and another of the old methods was Plaster of Paris soaked in a saturate solution of alum and baking the completed job. Plain Plaster of Paris and clean tap water makes a satisfactory cement for replacing some small pieces—one by which the case won't be lifted. If it is a very small or thin piece for a closely fitting surface, lime and the white of an egg make a satisfactory job, but it has to be worked quickly as it sets awfully fast.

We've had splendid results with one of the new cements called "G. C."; it is made by the General Cement Manufacturing Company of Rockford, Illinois, and comes in a 2-ounce glass bottle for 65c. It's generally carried by radio supply houses and hardware stores. Clean all pieces with steel wool, apply a thin coat to both surfaces and press together, allowing the completed job to set overnight or 24 hours is desirable.

Your French clock was made by S. Marti et Cie between 1889 and 1900, and while this firm is still in business, their Mr. R. Marti wrote the column in 1952 that all their clocks stamped "Medaille d'Bronze" and "Medaille d'Argent" are not repairable, that plant being destroyed. William A. Phelps, 4106½ Glenway Avenue, Cincinnati 5, Ohio, can take your old movement and make an escape wheel and verge to match. Write him for an estimate.

J. E. C.

*Dear Mr. Coleman:*

*I have a cuckoo clock with two large and one small bellows that is beyond my ability to repair. Can you recommend a reliable firm that I can send the clock to for repairing? Any help you can give me will be greatly appreciated.*

MILO M. SHAVER

*Shaver's Jewelry*
*Ovid, Michigan*

Dear Mr. Shaver:

We believe that you have a Cuckoo & Quail clock and that you are located convenient to Chicago. Suggest that you contact the Gem Clock Service, 5423 West 25th Street, Cicero 50, Illinois.

J. E. C.

*Dear Mr. Coleman:*

*I have enjoyed reading your column for quite a few years, but this is the first occasion I've had to write you. I've taken in a cuckoo clock for repairs and had the misfortune to break one of the bone or ivory hands—my problem, to be brief.*

*Is there a practical way to reglue the part together? Unfortunately, the break is across the opening for the minute arbor, and this minute hand has been made by hand, so there is no chance of purchasing a new one. I'll appreciate any help you can give me.*

GLENN A. BURNETT
*240 Russell Drive*
*Midwest City, Oklahoma*

Dear Mr. Burnett:

There just isn't any practical way to repair a bone cuckoo hand, especially when it's the minute hand and broken across the hole square. Most material supply houses are now well stocked up with cuckoo parts, including bone hands.

We note that you say this piece was handmade, and presume from that that you are indicating that nothing short of an exact duplicate will do. Suggest that you write to Braunschweiger Brothers, 46 William Street, Newark 2, New Jersey, as they have a complete cuckoo clock service and can make you a duplicate from the old piece.

J. E. C

*Dear Mr. Coleman:*

*I was a subscriber to A. H. & J. for a long time then dropped out, and now have been back in for about three months. I always enjoy and get an awful lot of good out of your Clockwise & Otherwise.*

*You are in the clock business, I believe, or at least some part of it, and I would like to know who would be the best man to send clock trade work to. I have just recently opened my shop here, and find that I have more clocks than I can handle, as no one else here does them. If you do this work yourself what is the average price, or maybe I should put it this way—what is the average price for clock work? I am a certified watchmaker and have done quite a few clocks, but not enough to really worry about whether I made or lost on one.*

*How in the world can I find out how to set the chime on a Westminster electric? Someone had gotten all that stuff out of kilter when I got the clock and I can't get it back to where it will chime right. I have several books, but none of them give me any help.*

E. J. ALLEN
*106 East 2nd Street*
*Taylor, Texas*

Dear Mr. Allen:

The term "clock work" is just about as broad as any we know, in fact it is so broad that we'd hesitate to even mention the average price even if you were to pin it down to a specific model. Customers never bring their clocks in for check-ups like they do their cars, and it is only when "old faithful" fails to run that it is taken off the mantel and hauled down to the clockmaker.

Maybe it stopped because it was moved for dusting the mantelpiece, and again chances are it has ploughed through months and months of dirt, dust and dried oil until every bearing in the train is badly cut. Write James L. Hamilton, Clock Manor, 1901 East Colfax Avenue, Denver 6, Colorado, about handling your trade-work, shipping instructions, etc.

There are several electric clocks chiming the Westminster tune on the current market—the Hug, Revere, Sessions, G. E. and Seth Thomas, to name a few of those most prominent. If you will write the Revere Clock Company, McMillan and Essex Place, Cincinnati 6, Ohio, you may obtain a service manual fully covering the Revere. If you will give us the make and model with some indication of the particular trouble, we'll do our best to assist you in getting it adjusted.

J. E. C.

*Dear Mr. Coleman:*

*I have a grandfather clock cabinet in which I would like to install a movement. Can you give me the addresses of suppliers of new and used movements in this area?*

CLARENCE S. GUILLET
*288 Mechanic Street*
*Southbridge, Massachusetts*

Dear Mr. Guillet:

A short while ago Meade Brothers, Inc., of 117 Pine Street, Philadelphia 7, Pennsylvania, were advertising brass eight-day

grandfather movements in good mechanical order with weights and pendulum.

For new movements write to A. C. Becken Company, 29 East Madison Street, Chicago, Illinois, and the Kuempel Chime Clock Company, 3611 Brunswick Avenue, Minneapolis 16, Minnesota.

J. E. C.

*Dear Mr. Coleman:*

*I have been a reader of your column in the American Horologist & Jeweler for several years and find it very interesting as well as being helpful.*

*I have a wooden wheel clock with brass bushings and verge escapement invented by Eli Terry, made and sold at Plymouth, Connecticut, by Seth Thomas. This is a weight-driven striking clock. Can you give me an approximate age from this information on this clock?*

FRANK HUGGINS

*Box 547*
*Swannanoa, North Carolina*

Dear Mr. Huggins:

The dates generally accepted as accurately covering the manufacture of wooden movement shelf clocks (note shelf, not tall) is from 1814 to 1837. The date of Mr. Terry's first wood movement patent is June 12, 1816, and Seth Thomas purchased from Terry for $1,000 the right to make this new patented clock, possibly in a short time after that date.

Toward the latter part of the wood clock era there was no particular advertising value to Thomas to include the Terry name on his label, as his own name was well established in the trade. For all practical purposes we might say that those Seth Thomas labels carrying also the Terry name were used in the 1820's.

J. E. C.

*Dear Mr. Coleman:*

*It is a privilege to state we surely appreciate and benefit immeasurably from your articles. We have at present a heavy clock mainspring winder with crank that has a double-way ratchet. We use it on all jobs, but by no means consider it an easy risk-free operation, especially with large mainsprings and their barrels or mainspring boxes.*

*We received instructions with winder to wind mainspring into barrel or main-*


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*spring box with winder as follows: Hook center of spring with winder, placing a few coils in the barrel, pressing gently at an angle against spring and winding the spring. It goes in very nicely, but I tried this method at least one-half dozen times over a period of time, each time feeling guilty.*

*I checked same by winding and compressing spring into retaining ring, releasing and removing, and found they are a little distorted—not bad at all, however, considering some I have seen. Maybe we are still doing something wrong. Your suggestions would be appreciated. Our treatment of barrels and mainspring boxes after the clock has been disassembled is to remove cap, if it has one, and fully wind mainspring up in the barrel, and put retaining ring or clip around the mainspring while in barrel.*

*We find the clips that come on mainsprings are usually too thick for the remaining space, and other ones we make up often are too weak. If the clip doesn't spring too much, one can unhook spring from barrel. Remove clip by winding up mainspring in winder, releasing tension on clip and removing. Then stretch out mainspring, except for a couple of coils, clean and lubricate, repeating process in reverse. Sometimes the clip is not strong enough, since a clean, oiled mainspring has more power.*

*To eliminate clip failures, your suggestions concerning type of construction and type of material used would be greatly appreciated. We also experience difficulty in shaping the inner coil of mainsprings, also in removing arbors, especially in barrels and mainspring box types. Suggestions would be greatly appreciated.*

*In several years of our inquiry with wholesalers and distributors on detailed operation of Bergeon clock mainspring winder, it has brought no results. They have offered to send me one for inspection and trial, but can't answer a simple question such as, "Can one remove mainspring from barrel with tool?" Their reply is, "We don't know if it can be done." We are interested in correct procedure.*

*I understand they are introducing another new model Bergeon clock mainspring winder. What is your opinion of the winder? We have found other Bergeon tools to be of quality, but fully realize that proper use of any tool is essential to its life and its productive efficiency.*

*I seek and would be forever grateful for knowledge to do this mainspring procedure in an orderly, risk-free, correct manner.*

EDGAR P. SCHMITT

*614 West 21st*
*Cheyenne, Wyoming*

Dear Mr. Schmitt:

It sure does the heart good to have letters that start like your—we scrounge around through books, lists and old trade journals in an effort to help fellow bench workmen solve problems. It's only when we hear from readers that we know whether or not all the time and effort expended hits the mark.

It is also a pleasure to have your attitude toward mainsprings expressed for the very simple reason that from experience we are convinced that many, if not most clockmakers, pay too little attention to the "powerhouse." Glad to see that you have a genuine desire to see that it is properly handled.

We can heartily agree with you on the Bergeon line of tools and are familiar with the mainspring winder they marketed a few years back. Didn't know that a new one was out or coming out—will check at once. My thought is that it is just as important to exercise care and do it with a winder when removing a spring from box or a barrel as it is when replacing it. Whether or not there is an "easy, risk-free" method, we are not sure. It might depend somewhat on your definition of easy and risk-free. Leastways, we've never seen a method that would fit a strict interpretation of it.

The very first thing I do to a mainspring winder is to remove or disconnect its ratchet because I never have use for same. The instructions you received with the winder you mentioned are essentially correct. However, I never place a few coils in the barrel when winding a spring in, for I find that a turn and a half is enough. All that is necessary is just to keep the wound portion of spring from catching on the outside end of the spring or barrel hook—the additional half-turn does the

trick.

It is true that one causes a very slight twist or angle bend near the outside coil, but this is of no consequence, and we have it on very good authority that this very same procedure is an established shop practice by a chronometer manufacturer. We know that their chronometers are hanging up some very, very good rates. It certainly should be okay on the "garden variety" of clock.

When the spring is taken out of the barrel with winder, you simply permit it to unwind by either backing the crank backwards or allowing the barrel to spin in your left hand, whichever is the easier. This leaves the spring perfectly free for cleaning, and right here, let me say I like your method of stretching out the spring for a thorough cleaning. Do you ever try rubbing it down with very fine steel wool? Now when you use the above method for rewinding the clip, time and trouble connected with it is again eliminated.

We know of one clockmaker who keeps a supply of heavy, soft wire (large) on hand, and before removing a spring, he will cut off a length, bend it in a loop horseshoe-wise and lay it handy. Then he winds the spring out of its barrel, latches the crank by the ratchet and, while still holding the barrel with the left hand, puts the wire loop over the spring and gives it a securing twist.

The barrel is unhooked, the spring taken from the winder and, grasping it with the left hand, he untwists the wire, permitting the spring to expand free for cleaning. The replacing operation of his is exactly the reverse; the spring is wound to a circle slightly smaller than the barrel, while the outside end is hooked to a fixture on the winder, the wire hook applied, it is removed from the winder and then inserted in its barrel.

All this to me is simply so much lost motion, when I can do the operation in half his time and know that my method is just as good. Sometimes his hook on the barrel fails to catch, while by this method it never fails.

J. E. C.

*Dear Mr. Coleman:*

*Can you give me information about the Bulle French electric clock and where I*


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*can obtain parts for it? I need a suspension spring for it, the "spring" being a piece of cloth—silk or similar material. How long should this piece of cloth be and what is the voltage of the battery which operates the clock? I thank you for the information you have given me in the past.*

JOE M. STEPANICH

*7648 Blackstone*
*Chicago, Illinois*

Dear Mr. Stepanich:

The Bulle battery clock was out of production for a good number of years. However, we understand that it has recently been revived. At the moment, there doesn't seem to be any U. S. importer and we feel that even if there were, he would not have parts for the old models.

The present producer is the Bulle Clock, 21 Rue Gambetta, Boulogne-Billancourt (Seine) France. However, by the same token, the chances are they have no parts for former (before World War II) models.

Sorry, we do not have in the files an exact length for the Bulle suspension. You can easily determine it from the clock itself. The solonoid pendulum should hang so that it rides or swings pretty near the center over the fixed bar magnet. Hold it in this position and with a pair of dividers or mm gauge, measure just how much silk should show between the chocks to hang it at that point.

Secure a piece of silk ribbon from the 5 & 10 the correct width, therefore you will have a suspension with selvaged sides that will not ravel. It is very necessary that the suspension be silk as it insulates the pendulum from the clock's frame electrically.

Bulle clocks operate on 1½ volts (one dry cell). If your battery dealer does not have a battery that almost fits, try a radio store. The larger the cell the longer it will last. Burgess Battery Company used to make a cell especially for the Bulle clock. It was their No. 312, but L. D. Foust, their sales engineer, writes that it has been discontinued.

There are a number of 1½-volt batteries on the market designed for use in portable radios whose cell is considerably larger than the largest flashlight cell. Generally they come in a square form, but on examination, you will find it to be a round cell in a square paper box; you can peel off the cardboard square and wrap or tape the cell and have a unit that will go into the clock.

J. E. C.

*Dear Mr. Coleman:*

*Could you give me the name of a supplier who can furnish plate jewels large enough for use in clocks? Thanks very much for your help.*

HUGH G. WALES

*409 West University*
*Champaign, Illinois*

Dear Mr. Wales:

Special jewels are made and marketed by the following firms: —John Worley Jewel Company, 19 Lane Street, Waltham, Massachusetts; Jensen Jewel Company, 333 Moody Street, Waltham, Massachusetts; Richard H. Bird, 1 Spruce Street, Waltham, Massachusetts.

J. E. C.

*Dear Mr. Coleman:*

*Can you give me the address of anyone selling one second or ¾ second weight driven movements (no chimes)? Thank you.*

JOHN MADDIC

*18 Wooding Street*
*Bristol, Connecticut*

Dear Mr. Maddic:

Write Seth Thomas Division, General Time Instrument Corporation, Thomaston, Connecticut. We believe that they still have some of their No. 2, eighty-beat regulators for sale.

J. E. C.

# Barnes, Dunbar and Manross—Bristol Clockmakers Past and Present

**By Reg Morrell, Curator, Bristol Clock Museum**

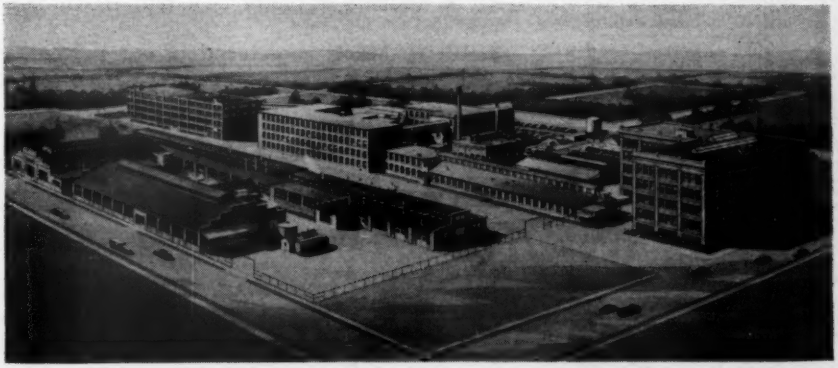
RECENTLY a salesman's sample box of old clock hairsprings was found where it had remained practically untouched for more than a half-century, in the vault of the F. N. Manross and Sons Division of the Associated Spring Corporation. Seldom does such an interesting find occur—one that is technically important to the horologist for replacement repair and stimulating to historic research. How often we wonder, when we see these old clock labels, what has become of the family names through successive generations in industry.

Today in Bristol, the names of *Barnes, Dunbar* and *Manross* are quite as significant in the life of the community as they were in the first quarter of the 1800's. What repairman or clock collector is not familiar with such names as Barnes, Darrow & Co., Barnes & Jerome and Thomas Barnes Jr. & Co.; Dunbar & Merriman and Dunbar & Warner, or Elijah Manross, Elisha Manross, Manross Bros., and Manross, Pritchard & Company. All were well-known names in clockmaking yet succeeding generations withdrew from this field and established industries as suppliers of parts to clockmakers and sundry allied lines.

Interestingly all three of these family names became associated with springmaking and all were direct descendants of the early clockmakers. Col. Edward L. Dunbar, son of Butler Dunbar the clockmaker, himself an apprentice of Silas Hoadley, purchased the Silas Burnham Terry process of tempering "flat coil" or clocksprings in 1847. Records show that he produced the springs for the infant "marine" movement industry and was continuously experimenting to improve its quality.

On January 11, 1858, the partnership of *Dunbar & Barnes* was formed (Edward Dunbar and Wallace Barnes). About this time, Wallace Barnes, the son of Alphonso of *Barnes & Jerome* and the grandson of Thomas Jr. of *Thomas Barnes Jr. & Co.*, a partner of Joseph Ives, and others had acquired the property and equipment of the *A. S. Platt & Co.*, clock movement makers—property which his father and grandfather had sold Platt in 1851 and the present site of the Wallace Barnes Co. on Main Street.

*Dunbar & Barnes* were prosperous springmakers supplying the clock industry and the feminine fad of the era, the



**The various divisions of the Associated Spring Corp. of Bristol, Conn.—Wallace Barnes Co., Dunbar Bros. Co. and F. N. Manross & Sons—as they are today, incorporated in one plant on the location of the original Dunbar & Barnes and A. S. Platt & Co.**

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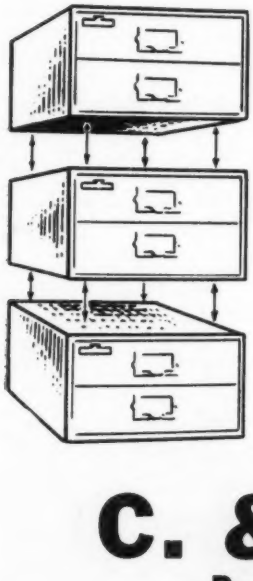

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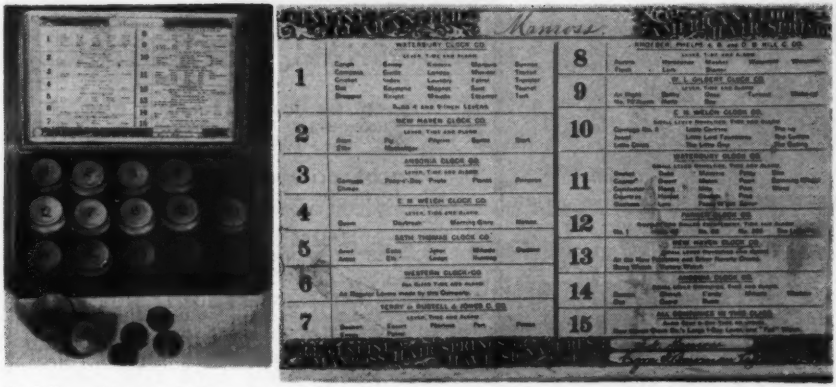


**At left, a 50-year-old box of clock hairsprings made by F. N. Manross & Sons; and right, label on the inside lid of the salesman's sample box containing the springs.**

**BRISTOL CLOCK MUSEUM—Continued**

spring steel hoop for the crinoline hoop skirt. This partnership continued until July 4, 1863, when it was dissolved—Col. Dunbar with his brother, Winthrop W., forming the *Dunbar Bros. Co,* and Barnes under his own name and subsequently *The Wallace Barnes Co.* now as competitive makers of springs and spring steel. Both companies continued until Dunbar Bros. Co. was purchased by The Wallace Barnes Co. in 1923 and both companies became a part of the initial structure of the *Associated Spring Corporation* on January 6, 1923, as separate operating divisions.

Frederick Norton Manross, the son of *Elisha Manross,* was the "foreman timer" for the E. N. Welch Co., contracting as was the custom of the times in factories, for timing marine movements and the making of hair or balance springs. In 1882, his contract having expired, Manross started making hairsprings in his home and soon was supplying these to all the major clock and watch makers. Manross continued as *F. N. Manross* until 1911 when he included his two sons, Arthur N. and Robert H., into the firm and it became *F. N .Manross & Sons.* The company prospered and in July, 1937, was purchased by and became an operating division of Associated Spring as the largest manufacturers of hairsprings in the country if not the world.

Hence three famous names in early Bristol clockmaking were combined and continued as divisions of the country's largest manufacturers of precision springs extending from coast to coast. Today they have the *Wallace Barnes Co., Dunbar Bros. Co., F. N. Manross & Sons,* all in Bristol. The *Barnes-Gibson-Raymond* of Plymouth, Mich., and its subsidiary, *The Cook Spring Co.* of Ann Arbor, *The William D. Gibson Co.* of Chicago and its subsidiary of Milwaukee, *The Ohio Division* of Dayton, *The Raymond Mfg. Co.* of Corry, Penn., *The Seaboard Coil Spring Co.* of Los Angeles and the Canadian subsidiary, *Wallace Barnes, Ltd.,* of Hamilton, Ontario, all operating divisions of the *Associated Spring Corporation.* The name of Barnes still heads this corporation with Fuller F. Barnes, grandson of Wallace as chairman of the board who with his brother, Harry C., the present first vice president, organized the Associated Spring Corporation and Carlyle F. Barnes II, the son of Fuller F. as the incumbent president. Carlyle F. II is the tenth generation of the Barnes family.

To add further clockmaker interest, on February 6, 1936, Edward Ingraham, president of the E. Ingraham Co., became a director of the *Associated Spring Corp.* and on April 22, 1953, Fuller F. Barnes carried the Barnes name back into the clockmaking industry by becoming a director of *The E. Ingraham Co.*

In 1952, F. F. Barnes, Arthur N. Manross (now retired from active business) and Edward Ingraham associated as directors in a new infant corporation—The

Bristol Clock Museum. Hence for a hundred and fifty years these great names have been and are still a very important factor in the life of Bristol.

This sample box, with its label of "F. N. Manross," must be prior to 1911 and with the mention of Western Clock Co., founded in 1895 and no mention of Sessions Clock Co. founded in 1903 of the Welch interests, undoubtedly places it between 1895 and 1903.

Catalogues of the various companies could perhaps fix a closer date by the model names. However, the finding of at least two samples in each numbered box and checking the models available, allows us to assume these springs to be the proper samples for the various listings. The essential characteristics of the springs of each box are as follows and it is hoped they may be of value to many repairmen.

Plant and office of Dunbar & Barnes.

An early photo of the F. N. Manross plant.

| Box # | Thickness | Width | #Coils | Outside Diameter | Hole Size |
|---|---|---|---|---|---|
| 1 | .004 | .026 | 8¼-8½ | ⅞" | .067 |
| 2 | .004 | .025 | 7½-8 | 1" | .063 |
| 3 | .0045 | .022 | 8 -8¼ | ⅞" | .057 |
| 4 | .005 | .023 | 8 -8½ | ⅞" | .069 |
| 5 | .0045 | .0215 | 9 -9¼ | 13/16" | .073 |
| 6 | .0043 | .0224 | 8 -8½ | ⅞" | .067 |
| 7 | .003 | .0255 | 8¾ | ⅝" | .073 |
| 8 | .005 | .018 | 8 -8½ | 15/16" | .063 |
| 8 | .005 | .0215 | 7¾ | 1" | .071 |
| 9 | .0045 | .0223 | 8 -8¼ | 15/16" | .065 |
| 10 | .0026 | .0155 | 8½-8¾ | ½" | .053 |
| 11 | .0017 | .017 | 9½-10 | 7/16" | .037 |
| 12 | .003 | .018 | 7¼-7¾ | 9/16" | .074 |
| 13 | .0017 | .017 | 8½ | 7/16" | .043 |
| 14 | .004 | .0197 | 9¾-10 | 11/16" | .073 |
| 15 | .0053 | .034 | 9 | 1⅛" | .087 |
| 16 | .004 | .024 | 7½ | 15/16" | .064 |

# THE BRISTOL CLOCK MUSEUM

*From a talk given by Reginald C. Morrell at the May, 1954 convention of the National Association of Watch and Clock Collectors in Canton, Ohio. Reprinted by courtesy of the N.A.W.C.C. BULLETIN.*

**Editor's Note: It is said of the enthusiastic Reg Morrell that he is engaged in enough projects to occupy 50 men. He became a confirmed clock fancier in 1947 when, pursuing woodworking as a hobby, he cut a wooden clock wheel for a friend. The clock became his as a gift, and that did it.**

**Currently he is working on the genealogy of all the old New England clockmakers, and making maps of the various plants and their locations. To date he has catalogued over 400 makers of cases, clocks, dials, glasses, etc., in the most ambitious project of its kind ever attempted.**

I AM delighted to have been invited here tonight to tell you about a project of which we are tremendously proud, and a

West and South fronts of Museum showing double "coffin doors" on South front.

**BRISTOL CLOCK MUSEUM—Continued**

tors in a new infant corporation—The project promoted by Members of the NAWCC for all those interested in the field of Horology for which NAWCC stands. This is the Bristol Clock Museum.

I thought you might be interested to know how this Museum happened to be founded. For a great many years our President, Mr. Edward Ingraham, and one of the original Founders and early officers of the NAWCC has been actively collecting clocks and clock history, filling up his home with specimens in which he was interested and which he knew would be interesting in the future. An illustration of his foresight as President of the great E. Ingraham Co. is: each year he has a box of *new* Ingraham clock releases packed away with instructions to open only after a period of 25 to 50 years. In this way, prime specimens will be continuously coming into the collectors hands in the future. His intense interest in clocks and clock history precluded his actively promoting such a Museum because of the pressure as head of his large company.

However, there were a few of us who were desirous that such a Museum be founded, and in June of 1952 at the annual convention of the NAWCC in Sturbridge Village, Mr. Charles Terry Treadway, a great, great grandson of Eli Terry and himself a noted collector of Terryana, came to me and said: "Well Reg, this would be an excellent time to have Ed. Ingraham announce that there will be a clock museum." And in the middle of the meeting floor, we approached Mr. Ingraham with the proposition. We must have struck him at an opportune moment because in a very short time he was called upon to say a few words and announced that he would devote his efforts and energy toward the Museum.

From June until October many of us were assembling bits of information, thoughts, and desirous activities for such an undertaking and most notably, Mr. S. Russell Mink, Secretary of the Associated Spring Corp., and an attorney, was hard at work approaching the various legal angles as to how such an Institution might be founded and have a tax exempt status.

In October of 1952 Mr. Ingraham invited the following group to meet with him at the Town Club in Boston to discuss a formal organization: Mr. Dudley S. Ingraham, Vice President of the Ingraham Co.; Mr. Fuller F. Barnes, Chairman of the Board of the Associated Spring

Mr. and Mrs. Hagans, Reginald Morrell and Edward Ingraham discuss clocks around the table in the historic Museum kitchen.

Orville R. Hagans examining the original account books of Eli Terry Jr. & Co., seated at Eli Jr.'s desk.

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Corp.; S. Russell Mink, Secretary of the Associated Spring Corp.; Clarence Ingraham, Treasurer of the E. Ingraham Co.; Judge Newell Jennings, Retired Justice of the Superior Court, State of Connecticut; Mr. C. P. Weldon, Superintendent of New Departure Mfg. Co.; E. Bartlett Barnes, Managing Editor of the Bristol Press; Charles Terry Treadway, Chairman of the Board of the Bristol Bank and Trust Co.; Reginald C. Morrell, Personnel Manager of the Associated Spring Co. We met with Mr. Ingraham and his delightful letter of invitation is an important exhibit in the Museum. From that meeting it was decided to formally organize, with the above men as the first members of the Corporation. Officers were elected and the Constitution and By-laws adopted. It was voted immediately to seek incorporation and when this was accomplished we would move forward immediately. Locations which could be purchased and much discussion relative to their merit followed without overlooking the fact that we might need to build a desirable home for the Museum.

In February a charming old house built in 1801 by Miles Lewis, a very early and well preserved example of the early Mansion Type home, came on the market due to the death of the third generation which had continuously lived in the house. The Directors were called together to purchase this house because it represented the beginning era of the clock industry and was beautifully located near the Federal Hill Green, the residential section of the Town during the great clockmaking era of 1810 to 1835. This is only one house removed from the J. C. Brown house which so many of you have seen painted on the tablets of clocks. At this meeting also a planning committee was appointed consisting of Reg. Morrell, Chairman, C. T. Treadway, C. P. Weldon and Justice Jennings who were instructed to formulate plans for the general contour, desires, aims, and purposes of the Museum. The Committee immediately went to work and reported to the Directors in April. The report was accepted and it was voted to proceed on the report of the Planning Commitee and to engage a fellow member, Mr. Ralph Myers, AIA, of Cornwall, Connecticut, as architect. For the next seven months a high activity of reconstruction and renovation went forward and continued through the decorating stages until mid-January when the Museum was entirely restored and ready to be set up.

I know those who have visited us will bear with me when I say, without bragging, that it is perfectly beautiful,—no expense having been spared to restore the lovely house as it might have been in 1801 to make it a very creditable presentation to the public.

We are rightfully proud of everything we have done and I am proud of the Directors and my part in the Organization because it has been the cooperative effort of all that has achieved the result. I made several trips to key cities of Philadelphia, New York, Boston and met with groups of well known collectors to seek their advice and information to incorporate into our plans and it was an immense thrill to see their enthusiasm and how they have cooperated to make this monument possible: Penrose Hoopes, Robert Franks, George Eckhardt, Dr. Cossidente, Dr. Small, Amos Avery, Walter Roberts, Ed. Burt, Brooks Palmer, the Stricklers, the

man of the Board of the Associated Spring Brandts, to mention only a few.

In the early days it was felt that a full time curator should be engaged. However, this soon did not seem feasible, not knowing how the Museum would be received by the general public and it was decided to move along slowly. At this time my company graciously allowed me to work in a dual capacity as Personnel Manager for them by day as you might say—curator by night. It has been a very happy relationship and the Museum was launched officially on April 10. From that time to the present some 1500 people have visited us and by their gracious comments I feel we have been well repaid for our efforts.

I've told you how the Museum was founded. Perhaps I should give those of you who have not had the opportunity as yet to visit it a rough idea of how it looks and our aims and purposes.

We like to feel that this Museum was organized to be a memorial to the great American clock industry which, I believe, we will all concede to be the fundamental motivating force at least, to the entire American industrial system. We felt that we also owed an obligation to the Citizens of Bristol since there was available in Bristol no old house completely restored as it might have been in 1800. We felt that we owed an obligation to those families who might visit for general interest on both sides, one of whom may be interested in clocks and the other, an old house. To that end we very carefully restored and redecorated the house as it might have been in 1800 making a formal Living Room, Kitchen, Library and Bedroom and using the other five rooms for concentrated clock displays. We also built in the old carriage shed a lovely three-room apartment for the caretaker and his wife who live on the premises all the time. Provision was also made for a hostess who has entire charge of opening and closing the Museum and welcoming people to its exhibit.

With this fundamental concept of a public offering we went forward to determine what we might do to render service to the public and to those who are interested in clock history. To that end we are establishing a very lovely Library with a very unique index system of clocks, manuscripts, photos, and clips of information of every sort so that ultimately any clockmaker may be studied from a folder where all known references to his work may be immediately at hand. A very extensive photographic Library is in formulation with some 400 photographs available at the moment. All of these services and all of this visitation to be without charge to the public or Collectors.

Ultimately, we undoubtedly will go into some type of publication. It may be monographs or it may be a periodic bulletin similar to many other historical societies. Rest assured it will never replace in any way the magnificent work that has, and is, being done on the BULLETIN of the NAWCC. We hope only to augment, with our publications, this type of collector communication. However, we do hope that our Library will be the repository of all of that information that is now scattered over the country and in the hands of few so that it may be made available to all.

Another project which we have in mind and plans are somewhat put together is for the establishment of a Registration Bureau for fine clocks. With the future files of photographs and information and description that we have of some over 350 clocks at present and over 200 items in our Library, where better could this information be collected and become available thru photographs and words, than in the Bristol Clock Museum? The project can develop itself to great lengths in the study of some of these fine old clocks whereby complete photographic records, descriptions and information will be filed and catalogued for future reference and the clock given a registry number in the Museum, the owner being given a registry tag to affix to the clock and a certificate for framing. How important that will be as succeeding generations come along and are interested in this great field of Horology for the owner of a private clock, who, perhaps is not interested in the clock other than a personal family heirloom, to say when they are approached relative to its study, this is entirely detailed and registered in the Bristol Clock

*Edwin B. Burt*
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Museum Registry No. so-and-so. A few years from now it will indeed be a thrill to make studies of these various clocks and clockmakers.

As the Library and its files, both by items and photographs build up, we are going to be more and more in a position of aiding you and your studies of clocks and clock lore and if we may aid you we feel that we have been of service.

I have talked entirely upon what we might do for you and now I would like to briefly mention what you might do for us. Our intense desire is to preserve horological information, old books, account books, memorabilia, letters, and anything at all pertaining to the old clockmakers of America. The Bristol Clock Museum is a Museum devoted to American Clocks and Watches and not, as is commonly and erroneously presumed, to be devoted to the Bristol Clockmakers. However, Bristol was the focal point of the industry. It had undoubtedly the greatest number of makers, and it is only logical to assume that probably greater space has been and perhaps will be in the future devoted to specimens as well as information pertaining to their work. However, we are all-American.

The interest in our exhibit has been tremendous. The great collection of Mr. Edward Ingraham, and the collections of Mr. C. T. Treadway and Mr. Dudley Ingraham were given to us as a start. Many, many others over the country have contributed clocks, tools, books and memorabilia for which we are deeply grateful. It is the purpose of the Museum to preserve these items, and we sincerely hope you will keep us in mind for such preservation. Should it be that a letter or article or book is not available to us as such, it may be possible that we may have a duplicate for our files. We would like every member of NAWCC to adopt this project as his own. We would like everyone interested in giving time, effort, memorabilia, or money, to feel free to do so. The museum is a Membership Organization and as such, we have Members from Maine to California to Texas. We want more Members for the participating effect. We want Members and Friends to think of us as a legacy bequest. We deeply want to perpetuate this great Organization and we want it endowed so that its future is assured.

We are going forward with intense confidence in the future that such a program will be developed and I know with your support, cooperation, efforts, and thoughtfulness that succeeding generations will be deeply grateful to you and to your support of this worthwhile project. Our true and underlying purpose must always be to appreciate the things of the past in order to better accomplish the things of the future.

* * *

Jewelers should never take sides in politics. Remember, both Democrats and Republicans have to know what time it is!

"What good is it? Pockets haven't been invented yet!"

# THE WATCH REPAIRMAN AND THE OSCILLOSCOPE

By Carl H. Anderson

AT THIS time of the year it is fitting and proper to extend season's greetings to all your friends and business associates. We not only wish to do this, but to also include all of the readers of our department in A. H. & J. We understand A. H. & J. is read regularly each month by more than half of the watch repairmen in the United States. So to all of you we say: Merry Christmas and a Very Happy New Year.

We sincerely hope that 1954 has been as good to you as it has been to us. We have much to be thankful for. During the year we have accomplished many of the tasks we set for ourselves. We are very glad to be able to report we know others who have done likewise.

Looking back over the year, we are glad of our trip to Denver because we became personally acquainted with the entire A. H. & J. staff. We were royally entertained by our good friends, Josephine and Orville Hagans. We learned much of the inside workings of the A. H. & J. One thing which particularly impressed us was Orville's "Clock Manor." From his very busy business day he took time to personally conduct Mrs. Anderson and me through "Clock Manor" and give us a personal history and explanation of the hundreds of unusual timepieces which are on display there.

Personally, we aren't much of an antiquarian, but when one sees and has explained to them the many historic timepieces which make up "Clock Manor," one cannot help but be awed and amazed. Here is the work of a lifetime of collecting unusual and historic timepieces from every corner of the world. Many of the watches and clocks which are on display are one of a kind, the one on display in "Clock Manor" being the only one in existence today anywhere in the world. One would be extremely irrational to even attempt to place a dollars-and-cents valuation on the entire collection since so many of the items are absolutely priceless.

We are not qualified to speak of other watch and clock collections, but we do believe "Clock Manor" to be one of the finest in the world. Certainly no trip to the Rockies by any member of our profession is complete without a visit to "Clock Manor." Whatever you do, don't miss it as it is an absolute must of your trip west. "Clock Manor" is open every day, Monday through Saturday, from 8 a.m. to 5 p.m. Certainly Josephine and Orville are due the applause of the entire profession for their untiring efforts, energy and expenditure of money to bring into being this wonderful collection. Our hats are off to them.

Another important thing to us of the year 1954 was our trip to the Chelsea Clock factory. We learned many important things about clocks from them that we never knew before. Mr. and Mrs. Walter Mutz were most genial hosts and entertained us wonderfully. When you read Jess Coleman's "Clockwise and Otherwise" department, you may have noticed he is always praising Walter Mutz for his splendid cooperation on clock topics. He is that kind of a fellow and should you ever want to know anything about Chelsea Clocks or need a part for one, you will find he will lean over backwards to help you out.

During the year we were privileged and honored to be the speaker at many guild meetings and conventions. We enjoyed them immensely. We feel we made

**Mr. Anderson will be glad to answer any question pertaining to the Oscilloscope. Queries should be sent to him in care of the American Horologist & Jeweler, with a stamped return envelope enclosed.**

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a whole host of new friends thereby. We have already booked several such dates for 1955. In the future we shall be glad to address any guild meetings or conventions where it is desired.

Quite unintentionally we stepped on a few people's toes during 1954 and to them we publicly offer our most sincere apologies. Personally we felt there were a few things in the field of watch repairing which needed straightening out, but apparently there were those who felt nothing should be said about them. We have heard every one of these things thoroughly and openly discussed at various guild meetings and conventions. We assure all concerned we did not start these discussions nor did we take any part in any of them. Our sin seems to lie in the fact that we put into print what every watch repairman already knew and had talked about. We personally know we did make any situation any worse than it already was.

• • •

In our A. H. & J. articles we have published during the past year, a considerable amount of information on watch repairing which has never before appeared in print anywhere else in the world, to say nothing of our exclusive information on the oscilloscope and its use in watch repairing. Those who have followed this department closely since it started have learned many things about watches they did not know before.

We know that during 1954 more than 1,000 watch repairmen seriously took up the use of the oscilloscope by having invested some of their money in one. The use of the oscilloscope by the watch repairman has increased by leaps and bounds. Its use has grown faster than anything which has ever been introduced to the profession.

We have consistently said in this department that if it is a question of buying either an oscilloscope or a timing machine, to buy the timing machine first by all means and get the oscilloscope later on. Why? It is far too difficult to get the time rate of a watch from present model oscilloscopes, although it can be done. We believe the thirst for knowledge of watch repairing has never before been as great as it has been since the introduction of the oscilloscope to the watch repairman.

We have received several thousand letters from all over the world asking for information on the various phases of the use of the oscilloscope in watch repairing and selling. We confidently believe the use of the oscilloscope will increase at a greater rate during 1955 than it did in 1954. Even the various oscilloscope manufacturers are now conscious of the fact by their increased sales that the watch repairman and the jeweler are now using the oscilloscope in ever-increasing numbers.

One manufacturer alone put through a run of 750 oscilloscopes of a model especially suited for watch repairmen in the late spring of 1954. On November 1 they reported to us that they now had less than 250 of them still on hand. They have no way of checking how many were sold to the watch repairmen, as they sell only to the radio parts wholesaler, but they feel the majority of this particular model was bought by watch repairmen

because of the fact this particular model oscilloscope is not suitable for use in FM and TV work. In fact they report a greater sale of this model than they have had on the combined sale of the three models they make for FM and TV work. If this particular manufacturer feels that the majority of the 500 of this model oscilloscope which they have sold since spring were sold to watch repairmen, we wonder how many oscilloscopes the other 35 manufacturers sold to watch repairmen?

We know of more than 100 of other make oscilloscopes which were sold to watch repairmen and we likewise know we do not know everyone who has bought an oscilloscope to use on watches. Every day we get letters from watch repairmen telling us of some other watch repairman who has bought an oscilloscope that we did not know of. If you could only read the hundreds of letters we receive from watch repairmen who took up the use of the oscilloscope during 1954, you would have some understanding of what a huge snowball is being rolled up at the present time. It only goes to prove that you cannot stand in the path of the wheels of progress for they will grind you down every time. It also proves the tremendous influence A. H. & J. has in our profession. Another 1954 accomplishment.

Unintentionally during 1954 we have upset the thinking of many old time, outstanding horologists. For example, we said that a flat hairspring can be made just as isochronous as one with an overcoil. Then there is a very large group who believe the balance never stops swinging or moving. This theory or opinion is quite easily disproven by the oscilloscope. Even some of the most skeptical now admit the balance does *stop*. More 1954 accomplishment.

Here are some other things which are going to upset a great deal more thinking. We will tell you more about them during 1955. Does the balance receive a greater impulse on one side than it does the other? Now don't jump to any rash conclusions; try to reason it out. *Yes*, the balance does receive a greater impulse on one side than it does the other. We have worked on watches during the past year where the impulse on one side was more than twice as much as it was on the other side. How do we know this to be true? By watching the trace of the tick and tock on the screen of the cathode ray tube in the oscilloscope. We cannot only see the greater impulse force on one side than the other, but we see it instantly and we can actually measure it, thus telling us *exactly* how much greater is the impulse on one side than the other. Has anyone else ever told you that?

Will you find a greater impulse on one side than you do on the other in every watch you work on? *Yes*. We have found this to hold true in every one of more than 10,000 watches we have tested on the oscilloscope. For those who have studied physics and/or mechanical engineering, there is a fundamental law involved here which is just as inflexible as the law of gravity. Will this greater impulse always appear on the same side, regardless of the type of lever escapement, such as equi-distant locking, circular pallets or semi-tangential or in an escapement with or without divergence? Yep—positively—the greater impulse is always on the same side and due to the aforementioned laws of physics and mechanics, it cannot be changed to the other side. Is there any type of jeweled lever escapement where it isn't true? Nope. What about a pin-pallet escapement? It is not true in a pin-pallet escapement. Want to know why?

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Another thing which upset the thinking of many was the statement that only with the oscilloscope could you always positively identify the tick and the tock. We want someone to show us any other method by which this can be done and *be correct each and every time*. Think *you* can do it? We are willing to be shown.

Then we mentioned the resuming and recovery rates of a watch. Hundreds wrote us they never heard of these rates so we quoted from the bulletins of the official testing bureaus of the Swiss Government and from our own National

Bureau of Standards. If there are no such rates, why do the governments of Switzerland, France, England and the United States (there are no others we have ever heard of who officially test watches, chronometers, etc., and issue a certificate thereof) include them in their official tests and put down these rates on the certificates and bulletins they issue and return with the watch? Do you remember our quoting our own National Bureau of Standards' requirements for the recovery rate of a railroad grade watch? If you will go back and re-read the article you will find the recovery rate allowed is exactly *one-third* of the difference in position rates. Does or doesn't that say our own National Bureau of Standards considers the recovery rate to be *three times as important as position* through our hat?

If you believe you are a good adjuster, take one of your jobs where you got very good position rates and send it down to the National Bureau of Standards at Washington for their test. If you get your watch by and receive a National Bureau of Standards certificate on your watch, we will pay the cost of the National Bureau of Standards test. If you want to try it, write us and we will give you full information on how to submit a watch to the National Bureau of Standards. Want to know where the watch will fail on the test? The recovery rate —remember, it must be three times as accurate as the allowance for the difference in rate between any two of five positions. There is one thing which is in your favor—your watch has to pass only a 5-position test, not 6 positions, and the crown down is the one left out on a pocket watch. Do you know how to take the recovery test rate on your watch? Do you know how to correct the recovery rate? If you don't, it is useless to submit the watch, because if you do not correct the recovery rate, your watch simply doesn't pass the test and that is all there is to it.

Here are some other things which will upset the thinking of many. Does the balance swing to a greater arc on one side than it does the other? *Yes,* it does. The clockwise and counter-clockwise bal-


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ance arcs are not the same. Is this always true? *Yes,* unless you have a rough pivot on the balance staff or a rough hole in a balance jewel. If the watch is in proper mechanical condition one side will always swing farther than the other side. Will it always be the same side, or in other words, will it always be the clockwise or counter-clockwise swing? *Yes,* it will always be on the same side. Can the swing be reversed? That is to say, if the longer swing is on one side, can this longer swing be changed so the other side is the longer? *No, positively no!* Can you change the law of gravity or any of the other laws of physics, mechanics, chemistry, etc.? No, you cannot, so don't butt your head against a brick wall by trying to change this one. Can this be found by any other instrument than the oscilloscope. Yes, the stroboscope. But the oscilloscope will always give you the correct answer.

• • •

Since we know the balance swings to a greater arc on one side than it does on the other side, is the speed of rotation of the balance faster on one side than it is on the other side? *Yep!* True again, the balance does turn faster on one side than it does the other, both on the outswing and the inswing. Can you make the speed of rotation of the balance the same on both sides or can the sides be reversed? No—absolutely no. Again you are monkeying with fundamental laws—the man has never yet lived who can change them. How the heck did we work out some of these things? It was easy—by the use of the oscilloscope and you just try to do it by some other means, believe it or not. Wonder if the balance swinging to a greater arc on one side than it does the other has any effect on the isochronous and position rates of a watch? You should be able to reason out the answer to that one. Yes, the isochronous and position rates are affected. How could you have perfect isochronism if the balance swings faster one side than it does the other? You figure that one out.

Since the balance swings farther on one side than it does the other and also swings at a greater rate of speed on one side than it does the other, is the longer swing accomplished in the same length of time as the shorter one? Well, you can answer that one yes or no. Depends on how technically accurate you want to be in your answer. If you say a difference of 1/10,000 of a second can be forgotten or discarded, then yes, both swings are accomplished in the same length of time. But if you say any difference of time whatsoever between the two balance swings should be taken into consideration, then the answer must be no, as the longer swing takes a very slightly longer time than the shorter one does.

We have had watches where the time difference between the two swings was more than 1/1,000 of a second, but in a good watch the difference is only of the order of around 1/10,000 of a second. What about the chart I get on my timing machine? Will I experience difficulty in getting a single, clean, in-beat line on the chart? You will always get a saw-toothed line, be it ever so slight. Depends on whether or not your timing machine will show a time difference of 1/1,000 or 1/10,000 of a second between the tick and the tock. Does this account for your not getting a single in-beat line from some watches that you labored over so long and so hard? We believe it does in part.

Does the force of impulse on one pallet stone actually decrease as the escape wheel tooth moves forward during impulse and the impulse force increase on the opposite pallet stone as the escape wheel tooth moves over it? Yes, that one is also true. In other words, when the escape wheel tooth strikes the impulse plane of the pallet stone the initial force is greater and before the escape wheel tooth has moved completely off the impulse plane of the pallet stone the impulse force has decreased to almost zero, while on the other pallet stone just the opposite is taking place. On the other pallet stone the escape wheel tooth strikes the impulse plane of the pallet stone with "X" force, and at the end of impulse the impulse force is not less than "2X." When the escape wheel tooth gives its initial impulse on one pallet stone the force of impulse actually decreases throughout the entire forward movement of the tooth. Does the oppo-

site thing occur on the other side? Yes. On the other side the force of impulse actually increases as the escape wheel tooth slides down the impulse plane of the pallet stone.

Does this always hold true in any type of a jeweled lever escapement? Yes—although the two impulse forces are more nearly equal in one type of jeweled lever escapement than they are in the other two types. Ever wonder how much these things affect the position and isochronous rates of a watch? You might be surprised one way or the other. The effect is much greater in the pendant right and pendant left positions than it is in the pendant up and pendant down positions. You get the greatest difference in vertical rates with the lever horizontal, on one side with the receiving pallet stone up and on the other side with the discharge pallet stone up. Just another reason why pendant right and pendant left are wrong and receiving pallet stone up and discharge pallet stone up are correct. Also, don't forget that this increasing and decreasing of the force of impulse has a marked effect on all of the vertical rates, as well as the isochronous rates.

We don't want to scare you to death because some of the foregoing things are quite easily corrected, while others are impossible of correction. The point is to know which is which and how long it will take to do the job. Also, please don't say, "This is all over my head," because it shouldn't be. Then don't say either that "I am not interested in these things," because these are some of the very things which defeat all of your laborious efforts to get good position rates, as well as trying to arrive at a somewhere-near-good isochronous rate.

Remember when we said "There is no such thing as drop lock in a running watch which is in good mechanical condition?" Also, that at let-off of impulse the lever flies over and strikes the banking pin, bounces back until the bounce is stopped by the guard pin striking the safety roller, all of this taking place before the escape wheel tooth can move forward to strike the pallet stone? Ever wonder how much these things affect the position and isochronous rate of a watch? You can bet your bottom dollar that since these things af-

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fect both the isochronous and position rates of a watch that they must be corrected or reduced to a minimum if your watch is to keep good time for your customer. We could go on with many other things, but they will come along in due course.

Yes, we know we have completely upset the thinking and staid ideas of many. But, as Al Jolson used to say, "You ain't seen nuthin' yet." No, we aren't radical, we simply started out several years ago to investigate a few things and have surprised ourselves at many of the answers. Can we prove these things? Certainly we can. Wouldn't we be sticking our neck out quite a ways if we couldn't? Then, too, wouldn't we be subjected to much ridicule and censure for trying to foist some untrue statements on you? Also, we could do serious injury to A. H. & J.'s reputation. Who but A. H. & J. has ever given you such information? No matter whether you or anyone else agrees or disagrees with our findings, *facts are still facts* whether you believe them or not. Two and two will always be four and not three or five. We still have a whole host of things up our sleeve as you will find out during 1955. We aren't magicians and cannot pull a rabbit out of a hat, but we sure can and will tell you a whole host of things which are true that you may never heard of. Will they be beneficial to you? Will they make a better watch repairman of you? That depends. If you use them, they most certainly will help you and make of you a much better workman than you now are.

There is one thing about 1954 which we deeply regret. We did not get to do all the research work we had mapped out for ourselves. However, we have now set up our equipment and work bench and since we no longer must be on time on the job every day in a jewelry store, we are perfectly free to do and complete some of the things we have had on our minds for several years. We have set up our research laboratory in one of the small office rooms on the ground floor of the apartment building where we live. All we have to do is go down the automatic elevator from the third to the ground floor, and walk about 15 feet after we get there. We shall be glad to show you our set-up if you ever get around this way. You will be welcome. Be sure to write us before you come and make a definite date so we will be sure to be in town.

We hope to be able to publish the result of many of the research projects we are working on during 1955. Be on the lookout for them and above all else, do not be surprised at some of our findings when the results are published. We sincerely hope our research work will be of much benefit to you. This is our ultimate goal as we want to increase the knowledge of every watch repairman and help him to do better work in much less time, thereby making his work more profitable to him.

Throughout all of 1954 we have consistently endeavored to show originality in our writings rather than initiative. By that we mean originality being the ability to create something, while initiative being the ability to start something which has already been created. All of our writings have been of a creative type. We have not been guilty of rewriting something which somebody else wrote before us. That is mere "rehash" and one soon tires of the same old story only told in different words. We firmly believe our readers want new things rather than old things with a new dress on. We have hundreds of new things yet to be explained to you. We know they will be of inestimable benefit to you.

• • •

We are receiving far too many letters every week from readers who have bought an oscilloscope kit and when they finally had it assembled, found it did not work properly. There are many reasons for this. One is that the watch repairman is not an electronic engineer. If he were, he would know enough not to try to assemble an oscilloscope kit. He would know that internally an oscilloscope is a highly complicated electronic instrument which requires a specialist to work on it properly. He would likewise know that the assembled kit would have to be thoroughly checked, adjusted and calibrated. He would further know that the instruments used to check the assembled kit cost three to five times more than does a factory assembled and wired oscilloscope.

So if he succeeded in getting the kit properly assembled and wired, he still has more work in front of him than he has already done.

The probability of getting the kit to work properly after it is assembled is quite remote. You are almost certain to have a distorted trace which results in improper diagnosis of what is wrong with the watch. Without complete knowledge of correct diagnosis of the trace of a watch tick, you could spend hours trying to correct a fault in a watch which did not exist in the first place. On the other hand, you might believe your trace to show a watch in good condition, when just the opposite is true.

You end up by sending your assembled kit back to where you bought it. They will make a very substantial service charge for whatever they do, as they usually completely rewire it. Then there is the charge for checking, testing, adjusting and calibrating. Add to all of this the express charges both ways and the original cost of the kit, so you wind up by having paid out more for your oscilloscope than you would have paid for a factory-wired oscilloscope in the first place. (Want the names and addresses of many who have had this experience? We didn't pick that one out of thin air!) In all of this we have not taken into account the time you will do without your oscilloscope while it is gone to the factory. You know how long it takes to get a watch back from the factory when you return one. Oscilloscope manufacturers aren't any better. It usually takes from four to six weeks to get your oscilloscope back.

Then, too, many oscilloscope kits have far too many war surplus parts in them on which manufacture has been discontinued. You do not find this out until one of these parts burns out or goes bad, then you learn it cannot be replaced, and there is nothing on the market which will take its place. Then you have to buy a new oscilloscope. That means you bought two to get one that really works.

One concern is selling oscilloscope kits which contain an eight-inch cathode ray tube. They bought up all of these eight-inch tubes when their use was discontinued in TV sets. You know that present-day TV sets have a picture tube which is


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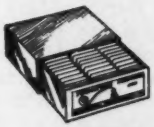

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twenty-one inches or larger. How long has it been since these eight-inch tubes were made? The manufacture of the eight-inch cathode ray tube (picture tube) has long since been discontinued by all picture tube manufacturers. In this case, whenever your eight-inch tube burns out, or fails to function, you soon learn you bought an "orphan" and the only thing you can do is to throw your old oscilloscope in the ash can and buy a new one, as your old oscilloscope cannot be adapted or changed to use any other size cathode ray tube.

Then there are a lot of radio parts wholesalers who have obsolete model oscilloscopes still on their shelves. Many of them will try to sell you one of these. Some will tell you it is obsolete, but there are more that won't because they are afraid of losing a sale if they tell you it is obsolete when you buy it. Others will cut the price on these obsolete oscilloscopes far below what they paid for it to try to sell it to you. Why waste your money? If you are going to buy an oscilloscope, why not get a good one in the first place?

We are laying this right on the line for you so that when you buy a kit to assemble your own oscilloscope you will know what you are actually getting into. The only logical reason we can see for so many watch repairmen buying oscilloscope kits is the price. If price is the deciding factor in your purchase of an oscilloscope, then why do you sell good jeweled watches? Why don't you sell your customer a $2.98 "no jewel, pin lever"? It runs, and it keeps time for a while. The condition is the same. You bought a "no jewel, pin lever" oscilloscope, only you didn't know it at the time. We are telling you straight from the shoulder without pulling any punches, like it or not. We are not connected in any manner whatsoever with any oscilloscope manufacturer, so we have positively no ax to grind. Buy a good oscilloscope in the first place. You will avoid a lot of grief. We will help you in selecting a good oscilloscope if you wish us to.

• • •

The last of October, some of the top executives of one of the leading oscilloscope manufacturers flew down to Lexington to set up a nation-wide method of handling the sale of one of their oscilloscopes to watch repairmen and jewelers. Probably one of the most important outcomes of the conference was that one of the Lexington radio parts wholesalers was authorized to sell this oscilloscope all over the United States. This applies only to their model which is ideally suited for use in watch repairing and selling.

Another highly important decision of the conference was that as these oscilloscopes are received by the distributor, they will be turned over to us. We will unpack and personally check each one of them. As each one is found to be in satisfactory operating condition for a watch repairman, we will attach to it a personal letter which states we have personally checked it and further that it is leaving our hands in satisfactory operating condition. We feel that our personal check of each one of these instruments should be sufficient for all A. H. & J. readers. There is nothing added to the price you pay for this service, but we admit we are being paid a very modest fee for having rendered the service.

This manufacturer is also setting up a time payment plan through the Commercial Credit Corporation for the purchase of these oscilloscopes. The terms such as the down payment, monthly payments, finance charge, etc., can be had by writing us. We believe that by having accomplished these things we will actually save money for A. H. & J. readers in the purchase of an oscilloscope. We understand this manufacturer will begin advertising these oscilloscopes probably in the January, 1955, issue of A. H. & J.

• • •

Another important event of the past month was a visit from a manufacturer who will have on the market by the time you are reading this, an entirely new electronic instrument which not only gives the position, isochronal and temperature rates of a watch, but *also the resuming and recovery rates*. This party told us in our conference they had never even heard of the resuming and recovery rates of a watch until they read about it in this department of A. H. & J. He also said they had investigated and found that not only did

these rates actually exist, but also they were the most important of all the rates of a watch. After thus verifying our statements from disinterested sources they decided they wanted to be the first to offer an electronic instrument which would include the showing of these rates. In so far as we are able to learn, this is the only instrument which will give you all of these rates. They are shipping us one of these instruments for a complete test in our research laboratories and by the time you are reading this we should have completed at least four weeks' experience with it. If you wish to know more about this instrument, drop us a line and we will tell you where to find out. There will probably be an advertisement of this instrument in this issue of A. H. & J., as it will be distributed by a regular A. H. & J. advertiser. The price—$119.50. The size —smaller than your staking tool box, so you can keep it on your bench right in front of you.

• • •

We have briefly sketched for you what we consider to be some of our 1954 accomplishments. There were still others which are just as important or possibly more so which we are not ready to disclose to you. Watch and read very carefully our articles in 1955 because we may drop in a paragraph every now and then which may further open your eyes. Every month we are adding to our store of knowledge and sincerely hope you are benefiting thereby.

• • •

Since we are the writer of this department and at the same time, the Founder and Executive Director of the Institute of Horological Oscillography, we feel we should make a public statement about the relationships which do and do not exist.

As the writer of this department, we must respect and stay within the wishes and editorial policy of A. H. & J. However this does not in any way affect the Institute. Neither does A. H. & J. nor this department have any connection whatsoever with the Institute. The only possible relationship between the Institute and A. H. & J., is that of advertising client and publisher. The Institute neither receives nor expects any special favors from A. H. & J. The Institute is just another


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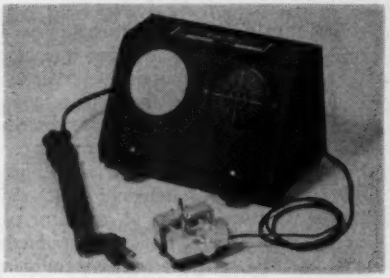

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advertiser in A. H. & J., so far as both are concerned. The Institute in its policies is not in the least influenced by A. H. & J.

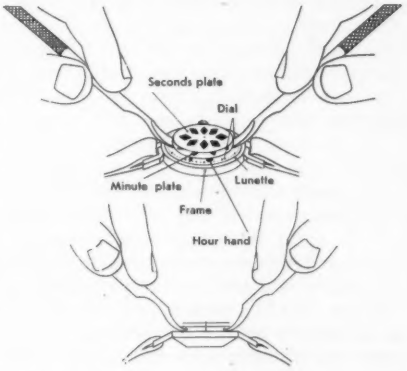
As of now, every member of the Institute is a reader of A. H. & J., for which we are thankful. Quite naturally the Institute will do everything it can to increase A. H. & J.'s subscription list, because by so doing it will be benefiting anyone whom it causes to become a subscriber. The Institute makes such statements to its members as it feels to be true and justified. Many such statements will never even be submitted to A. H. & J. for publication. The articles which are published in A. H. & J. are practically wholly and totally different from the Institute's correspondence course, monthly bulletins and news letters. At least 80% of the material contained in the Institute's course has never before been published anywhere in the world, neither will it be published in any magazine. Neither A. H. & J. nor the Institute can in any way be held responsible for the acts of the other. A. H. & J. is not and never will be mentioned by the Institute in its correspondence course. The Institute will never use this department of A. H. & J. to further its own interests. It will derive its new members wholly from its advertisements in A. H. & J.

The Institute believes its initial advertisement in A. H. & J. holds all records for responses. Not only that, but another record has been established by the fact that more than 50% of those who answered the October ad, enrolled for membership within one week after receipt of their inquiry. This is still holding true. The Institute is very happy to be able to state that as a result of its October ad in A. H. & J., a very substantial percentage of the memberships available for 1955 have already been allotted. This proves beyond all doubt the reader response of an ad in A. H. & J. If you have something of real value to the watch repairman, an ad in A. H. & J. will sell it for you. So, Mr. Advertiser, if you have a real story to tell the watch repairman about something he needs, A. H. & J. is the medium through which to tell him about it. And we aren't in any way connected with A. H. & J.'s advertising department either. The Institute pays the same price for its ads that every other advertiser does.

Hey! This department is supposed to be devoted to Horological Oscillography and not to selling you the results of an ad in A. H. & J. Forgive us, but we just could not resist the opportunity of giving a boost where one was deserved.

So MERRY CHRISTMAS, HAPPY NEW YEAR, SEASON'S GREETINGS, etc., from us to all of you. May you eat plenty of turkey, dressing, cranberry sauce and all of the trimmin's.

## DISMANTLING AND ASSEMBLING THE BOREL 'COCKTAIL' DIALS




In the 32nd number of its house organ, *Rendez-vous,* the Ernest Borel Co. of Neuchatel, Switzerland, gave directions on the removing and replacing of the rotating dials on its revolutionary new "Cocktail" watches.

As shown in the accompanying diagram, a good pair of levers are needed to remove the discs. After inserting them under the lower (minute) plate as near the center as possible, a slight pressure under both discs, as in the case of ordinary hands, will lift them both up and free them from their pinion.

To replace the discs, the same procedure is followed as for conventional hands, taking great care, however, that both the lower and upper plates are perfectly flat and that there is no warping whatsoever once they have been set into action by means of the button and stem.

# Jewelry Repairing

By R. ALLEN HARDY

## General Discussion On Tools (con't.)

MANY of the small tools used by the watchmaker are equally useful to the jeweler. There is the watchmakers' anvil with its numerous holes and slots that offer a perfect working surface for the jeweler. This small anvil is used for riveting, flattening and straightening various articles. In selecting a good anvil, be sure it is of correctly hardened steel that will stand up under plenty of abuse.

Beading tools are used in forming beads when setting or tightening diamonds. The average set comes in 12 assorted sizes, complete with handle. These tools should be made of the finest steel as their edges are subject to great pressures during the forming of a bead, and inferior metal will not stand up. This is, of course, a perishable tool—one that will wear out through continued use.

A bench brush is a very useful item for the jeweler. Not only should the surface of the bench be kept reasonably clean during the working day, but unless gold filings and sweepings are carefully brushed into the lap drawer, dollars may be wasted through carelessness. It is advisable to develop a habit of "brushing off" after each job. It only takes seconds.

Buffs, brushes and polishing abrasives were covered in a previous edition of the A. H. & J. and treated as a special subject. There is a very little to add on this score with the exception of mentioning a fairly new development relative to the emery paper, cone, and stick category. As every experienced jeweler knows, emery paper has its definite place in a jeweler's list of essentials, be it flat paper, shells or flat, wooden buff. There is a product available that is a cloth rather than a paper, and it may be purchased in the same forms that have always been available in emery paper.

The ring clamp (double end) is a very standardized part of a jeweler's equipment that is hardly worth comment except to say that it may be used for many jobs other than ring work. Rings may be held in this tool while filing, polishing, setting stones or engraving. This tool may be used as a vise when more flexibility of movement is needed than is possible when using the steel bench vise.

Spring dividers are especially handy fo ring sizing. They can be opened to the exact size of ring reduction (or expansion) and then accurately marked off on the shank of the ring (if being reduced) or the gold stock (if being expanded). The sharp steel points make a clearly visible line on the gold, which is easy to follow with the jeweler's saw *(Fig. 55)*.

A steel marker is a very handy tool, this being a finely tapered steel point mounted in a knurled handle. During the course of a working day, the jeweler has as much use for this tool as a watchmaker has for a bench knife. One important advantage of the steel marker is its adaptability for converting into a first class pin-pusher. Slight alteration to its point is, of course, necessary *(Fig. 56)*.

The jeweler does not have to use a loupe nearly so much as a watchmaker, but it is important to have adequate loupes within easy reach. For average jewelry work, the engraver's loupe (4″) is usually strong enough. For stone setting, a 1½″ to 2½″ loupe is good. (4″ is 2.5x—2½″ is 4x—1½″ is 7x.) A stronger loupe, such as 18x, may be used for close inspection of diamonds and other very critical work, but is much too strong with which to do actual work. An 18x loupe brings one too close to the work to allow

**Mr. Hardy invites your questions pertaining to jewelry repairing. Questions should be directed to Mr. Hardy, c/o The American Horologist & Jeweler, Box 7127, Capitol Hill Station, Denver 6, Colorado. Please enclose a self-addressed, stamped envelope.**

Fig. 56

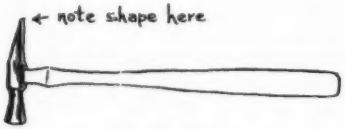



Fig. 57

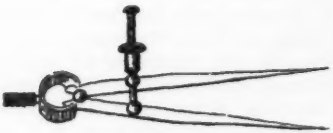


Fig. 55

Fig 58

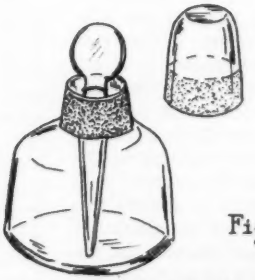


Fig. 59



for clearance.

Files cover such a wide range and variety it is hard to advise the beginner precisely which file to purchase. Opinions are apt to be varied since there are a number of ways to arrive at a good polish on any article by means of files, emery, tripoli and rouge. Files usually are purchased in a No. 0 to No. 4 range, flat, half-round or barette. It is hardly necessary for the jeweler to use over 2 cuts of files—No. 2 and No. 4, in flats, half-round or barette.

A complete set of jeweler's needle files in the following shapes—round, square, three-square, entering, knife, half-round, crossing and barette—is well worth the investment. They are essential for finishing and forming small work.

Hammers are a very essential part of the jeweler's equipment. The Swiss-style riveting hammer should be selected with great care. This is a delicately balanced hammer with one flat or pounding side

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and one wedge-shaped or riveting side. The riveting side deserves special attention. The best riveting shape is slightly rounded—no sharp edges *(Fig. 57)*.

The jeweler's ball peen hammer, of medium light weight, is a fine little hammer for numerous pounding jobs. This hammer is especially useful to those jewelers employed in the metal arts and crafts field, being used in conjunction with many chasing operations. The jeweler in the average jewelry store is hardly called upon to do such highly skilled work, but nevertheless, the ball peen hammer is valuable to him for countless other uses, one of them being the simple pounding of a piece of gold, inserted in a ring to make the size larger.

Frequently, the gold stock on hand is slightly thicker than the ring shank. Taking this into consideration, the jeweler will not have to add as long a piece of stock as he customarily would; for pounding with the hammer, after the piece is soldered into the ring shank, will expand the section of gold to the size desired. The thickness is reduced accordingly to the thickness of the ring shank with the result that very little filing to size is required.

An ordinary alcohol lamp, similar to the watchmaker's alcohol lamp, will serve the jeweler very well for ordinary soft solder operations. The one choice in selecting such a lamp is the size of the wick —usually ¼" or ½". The larger size is generally more useful.

The jeweler's bench lamp should be just as fine a lamp as the watchmaker uses, particularly if he is to set stones. A fine quality of light means a fine grade of work. Selecting a bench lamp is hardly a problem these days since improvements are being made continually in adequate lighting.

The rawhide mallet is essential in pounding ring shanks into shape on the steel mandrel. After continued use, the faces of the mallet lose their shape, become nicked and distorted from their original shape. This is to be expected since it is the nature of rawhide to do just that—and this condition is no hindrance to its usefulness. Its purpose is to pound without damage to the ring shank, and a misshapen face does not hinder that purpose *(Fig. 58)*.

If it is desired to have a mallet with a harder pounding surface or face, but one that will not damage or mar the surface of the article, then consider the fiber-faced mallet. This may be purchased with a 5-ounce weight and ¾" face and with detachable hard fiber faces.

There are many other variations of mallets or hammers that the beginner or old-timer might find particularly suited to his own needs. For instance, there is the small brass mallet used by the watchmaker for staking operations, the brass and fiber-faced mallet in light and heavy weights (also a favorite of watchmakers) and the heavier ball peen hammers. Everyone to their own liking and preference, the main consideration being skillfully and neatly executing a given job.

It seems that a jeweler cannot acquire too large a selection of pinvises. During my entire experience at the jeweler's bench, I seemed to be continuously adding new pinvises, here and there, to my collection. The strange part is that I always seemed

to find a use for all of them, in spite of the fact that I was indulging in a whim and probably did not need them all. Any supplier's catalog will show pinvises galore in all sizes. There is hardly anything to say here except to be sure to select a good range—from the smallest to the largest.

Jeweler's saw frames should be very carefully purchased for here is a piece of equipment that is used many times during the jewelry repairer's day. For average use, a saw frame with a 2″ depth is handiest and easiest to maneuver. It is well to have on hand frames of a greater depth, such as 4″ and 6″ frames. Deep frames are necessary for sawing out large plates or sections of metal and for piercing work impossible to handle with the 2″ depth frame. Most jeweler's saw frames are adjustable from 0″ to 5″ to take care of whatever length of saw blade being used.

The average run of jeweler's saw blades range from size No. 4/0 (very fine) to No. 4 (very coarse). The manufacturing jeweler may find a use for each size, but the average jewelry store technician can do very well with about three sizes—fine No. 3/0—medium No. 1 or No. 1/0—and coarse No. 3. These blades are very fragile, easily broken and it is advisable to carry an adequate reserve stock at all times.

An electric soldering iron is a very handy equipment item for soft soldering "hard to get to" places and for pieces of jewelry with delicate finishes that will not bear up under an alcohol flame. They may be purchased with a simple plug-in for 110-volt, 60-cycle A. C.

Soldering blocks may be purchased in asbestos or in charcoal. One works as good as the other, the only consideration being the durability of the medium. Charcoal is very light and very susceptible to breakage if abused. It is a good idea to anticipate this feature by wrapping the block with light binding wire. This wrapping, of course, is done around the sides. Asbestos soldering blocks are more durable and may be purchased in a variety of shapes.

Jewelers' shears are used for many miscellaneous operations, one of the most frequent being the operation of cutting off solder from the sheet. These shears should be of good steel, correctly hardened. One feature to watch for in purchasing shears is the freedom of operation. The joint where the two sections are put together should have just the right amount of freedom, else they will be cumbersome to handle and a constant worry. They should not be so free that the handles fall together of their own weight, neither should they be so tight that an excessive amount of pressure interferes with the accuracy of the intended cut. If it is possible to select shears from several pairs, be sure to select the one that meets the above qualifications.

Gold testing needles (for yellow gold) and gold testing stones may be purchased separately or together. There are usually nine needles ranging from 4 to 20 carats with each needle numbered in two-carat graduations. The usual way to test gold is to rub the questionable article on the gold testing stone, then rub about three needles of different carat (10, 14 and 18, for example) close to the original mark. Next, using the glass stopper from the nitric acid bottle (this stopper is tapered so the the tip may hold as much or as little acid as is required), rub a little acid over all the gold marks.

The nitric acid seems to intensify the color of the gold and the two marks most nearly matching will be readily apparent. This will determine the exact carat or the closest to it.

Acid bottles are rather a standard type of thing. The usual design will hold only a few ounces of acid. The shoulder of the bottle and part of the cap fitting over the shoulder is of ground glass, which prevents evaporation. The stopper is also of glass, shaped with a long taper that reaches very close to the bottom of the container. It is very necessary that all acids be kept in this type of bottle, for without the protection of glass the liquid and fumes can cause serious damage. It is suggested that even though all bottles containing acids are properly handled, they should also be plainly labeled as such *(Fig. 59)*.

This concludes the discussion on tools and equipment of interest to the beginning jeweler. There are more, but it hardly seems wise for a beginning jeweler to consider everything he might have a

use for until he has learned to use the fundamental tools and equipment. It would appear that learning to do a job well with as few tools as possible is a worthy attainment.

Our next subject will be of a practical nature—discussing actual problem jobs that seem to walk into a jewelry store all too frequently.

And now is a good time to thank everyone for their interest in this department throughout '54, and to wish everyone, everywhere a very Merry Christmas and a prosperous New Year.

R. ALLEN HARDY

* * *

## Correspondence

*Dear Mr. Hardy:*

*I have just started back to taking the American Horologist & Jeweler, and have just put in this little place of my own. I do watch repair, jewelry repair and stone setting, and sell bands.*

*I have looked the country over for about five years to find some book that would do for me what you have done in the August issue—tell a guy what to do and draw it off. I have been taught by some of whom were supposed to be the best stone setters in the country, but I have never been satisfied with the answers I got, and was never really satisfied with the work I turned out. I am a Certified Watchmaker and like for all my work to be as good as my watchmaking, and jewelry repairing. I do not know how much you have given on jewelry repair and stone setting, but I have a lot of trouble when it comes to kicking up a bead, and making a good, bright cut or finishing it off.*

*Have you written a book on the subject or do you plan on going on with your articles in A. H. & J.? I know stone setting is just a matter of getting the metal over the stone to be as strong as possible and as attractively as possible, but I also know there is always a best way to do a job, and I feel like you are the only guy I have read about that could do the job, and tell how he did it. I was an instructor in watchmaking, and I know it is easier to tell how to do it than it is to do it.*

*I have The Jewelry Repairer's Handbook and Hand Made Jewelry by Wiener, and have some lapidary books that give*


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*some information on stone setting, but none of them really tell a guy what tool to use at what time, and all that. I know there are lots of different heads, but if I had about a dozen of the most popular ones drawn and shown how is the best way to set the stone in them, I am sure I could handle anything that came into my shop.*

*I want to thank you in advance for any help you may be able to give me.*

ERNEST J. ALLEN

*106 E. 2nd St.*
*Taylor, Texas*

Dear Mr. Allen:

Your comments concerning my articles are very much appreciated.

If you will get the June, July, August and September issues of A. H. & J. together, I am sure you will find answers and illustrations to all the problems you seem to have concerning stone-setting

In answer to your inquiry concerning a book on the subject—yes, I have written one, but it probably will not be in print for at least a year. I do intend to go on with the articles in the A. H. & J. and although I have already covered stone-setting it appears that I must go back to the subject in view of the increased demand for more information on that subject. Keep an eye on subsequent issues of A. H. & J.

R. A. H.

*Dear Mr. Hardy:*

*I have found your articles on jewelry repairing, especially stone-setting, very instructive and feel that these articles are long past due as a service to watchmakers who spend so much of their time with watches and have little opportunity to learn jewelry repairing.*

*As a step in the direction of learning more about stone-setting, can you recommend a good textbook on the subject? Any information you can give and how the book may be obtained will be appreciated, and again, let me thank you for your very instructive articles.*

MAX S. LEVINE

*308 Sterling St.*
*Brooklyn 25, N. Y.*

Dear Mr. Levine:

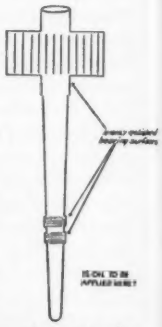
Your comments about my articles are very kind. Actually, they are intended to be of service to watchmakers who would also like to develop jewelry repair and stone-setting abilities.

I am sorry to say that I cannot suggest a book on stone-setting, for I was not able to secure an adequate reference or textbook when I was instructing at Bowman Technical School in Lancaster, Pa. I do think there have been some writings on the subject since then, but I do not have the information. Almost all the good jewelry books I can suggest are devoted to manufacturing techniques and these did not help me when I was a student interested in learning fundamentals of jewelry work.

R. A. H.

*Dear Mr. Hardy:*

*Would certainly appreciate very much indeed if you will advise me if, when assembling a movement after cleaning, should you apply oil at any point on the "sweep second and pinion" onto which the sweep second hand is carried?*



*I notice that directly "under" the pinion there is a smooth bearing surface, also further down near the opposite end there is another bearing surface, as the enclosed drawing shows what I mean.*

GEORGE BANCROFT

*Greenup, Illinois*

Dear Mr. Bancroft:

I have some very positive ideas on just how to handle your problem (I am a Certified Watchmaker, though hardly an authority), but I feel that I am forced to reserve comment, since a far more capable man than I, Mr. Samelius, specializes in your type of query.

Suggest you consult his department.

R. A. H.

*Dear Mr. Hardy:*

*Thanks very much on your most-appreciated articles on Jewelry Repairing.*

*Thanks to you, we are now setting all our own diamonds. One of the other jewelers here in town and myself have run up against the same problem in setting*

*melee in a flat top setting, i. e., in setting a row in a wedding ring of one pointers, something happens to our eyes and we cannot see what we are doing after about the second melee is set. Is it customary to have to set a few of these and then have to take a coffee break for our eyes to re-adjust, or are we using the wrong eye glasses? They are a little too small for our regular 3" or 2½" eye loupe, so we have been using our pivot loupe (½"). I tried using the 18x loupe, but it is in the way of my tools.*

CARL NISSON

*913½ Eye St.*
*Modesto, Calif.*

Dear Mr. Nisson:

It is always gratifying to hear that someone has benefitted from reading my articles such as you say you have.

Concerning your problem of loupes, it seems to me that you are using too strong a loupe. I have never found it necessary to use a ½" loupe to set these stones. While you are actually working on it, a 1½" to 2½" loupe will give you the clearance you must have. This should also give you enough magnification.

I believe you will find that as you set more stones your eye will become more and more critical and the tendency will be to use a weaker loupe rather than a stronger one.

I feel sure the strong loupe is the reason for your eye condition. Train yourself to use a weaker one.

R. A. H.

*Dear Mr. Hardy:*

*Your series of articles on Jewelry Repairing has pleased me very much. It is just what I have been looking for so long. I hope that you will have an article on all the different methods of stone setting. Most books on the subject are very vague and unsatisfactory.*

*I wish that you would have some material on the methods used for removing engraving from jewelry, etc. This seems to be rather neglected, also. I happen to have a white gold 14-carat watch case with a monogram on the back and some engraving on the inside. What can be done with it? Can the monogram be filled with gold or just what method would be employed? Any information will be very much appre-*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*ciated.*

HUBERT KUCERA

*Riverside, Iowa*

Dear Mr. Kucera:

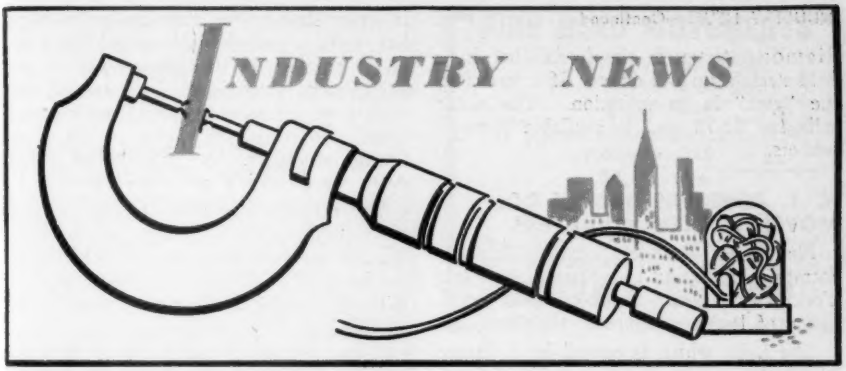
Your comments are most appreciated. If you will continue to follow the articles, I am sure you will find they will cover most practical work that comes into the average jewelry store, including the removal of engraving from jewelry.

To answer your particular query, the monogram can be obliterated by using a very thin plate of gold soldered over the engraving, or by soldering strips of thinly-rolled gold over the deepest cuts. To hope that ordinary solder will flow into the engraving and smooth itself out is pure folly. Solder is not meant to fill in gaps but to join two pieces or sections of metal. Solder must have real metal to travel on if it is to bridge any gaps.

Even though a thin plate or strip of metal may be soldered over the engraving, after the surface is smoothed out (by using file, emery and/or buff) the design of the original engraving can usually still be seen. This is due to the solder alloy. On any fill-in work it is rare indeed that the fill-in (be it white or yellow gold) shows up with the same color tone as the original metal. I have found it advisable to warn the customer that perfect results cannot be guaranteed.

R. A. H.

"See anything worth swiping?"




## ALL PURPOSE METRONIC LATHE IS INTRODUCED

Schultz & Anderson Co., 109 Edison Place, Newark 5, N. J., is making available a catalog introducing the Metronic All-Purpose Lathe, a high-precision lathe that is said to meet every standard for quality and performance.

The headstock, tailstock and bed of the lathe are one-piece, close-grained gray cast iron, thoroughly seasoned, and are interchangeable. The castings are rough machined, aged, and finish-machined to ex tremely close tolerances.

Eleven inspections on the lathes during the various stages of machining are performed, and each casting is tested for soundness, straightness, and dimensional accuracy, including indicator readings to plus or minus .0001.

The complete motorized unit is mounted on solid-finished hardwood base with four rubber feet, motor wired to off-on switch, flush type, with a six-foot rubber plug-in cord. The unit is portable, weighing approximately 30 pounds. The mounted design permits its being used on any workbench in shop or on desk, etc. The method used in mounting to base is said to eliminate noise and vibration.

The complete unit, which requires no installation, includes the standard equipment of lathe (bed, head and tailstock), tool slide, tool post, draw bar unit, and one collet, motor pulley, V-belt, motor, switch, base, and connecting rubber cord. Motors are 1/15 h.p., 3450 r.p.m., 60-cycle, 110-volt, one-phase.

Further information regarding various Metronic models and the catalog should be directed to the Schultz & Anderson Co.

## 8-DAY CLOCKS A FEATURE AT HENRY COEHLER COMPANY

**Exclusively featured by the Henry Coehler Co., 101 Fifth Ave., New York City, is the escapement watch, which strikes the hour and "Record", (right) an 8-day, 4 jewel lever half-hour on three rods. Case is of mahogany and walunt, dull hand-finished. Size: 13½"x 6½". Keystone, $48.00.**

**The "Comet" (left), another of many clocks available exclusively at the Coehler company, is an 8-day pendulum clock, which also strikes the hour and half-hour on three rods. Case is of mahogany and walnut, antique finish. Size: 9"x10". Keystone, $48.00.**

## LAMPERT MARKETS TESTER FOR DIAMONDS AND "GEMS"

A diamond tester that is guaranteed to distinguish between a real diamond and an imitation is now being marketed by M. J. Lampert & Sons, Inc., 352 Fourth Ave., New York 10, N.Y.

This diamond tester has been developed because of the recent influx of white sapphires and white spinels, which, according to the firm, have been so carefully cut and precisioned that many top experts have been fooled.

The company states that use of the

diamond tester is simple in that it is held straight up and down. If it scratches, the "gem" is an imitation. The tester sells for $5.75 and is available through jobbers.

## N. Y. JEWELERS SUPPLY CO. MOVES TO NEW QUARTERS

New York Jewelers Supply Company, formerly located at 132 Nassau St., New York City, recently announced its occupancy of larger quarters at 87 Nassau St.

The firm, which is owned by L. Bauer and S. Chasin, carries a complete line of watch materials, tools, jewelers' supplies, and findings.

## PERFIT CLOCK GLASS CATALOG FEATURES REPLACEMENT LINE

American Perfit Crystal Corporation just issued a new clock glass catalog which illustrates a complete line of replacement glasses for all clock styles including desk and travel clocks.

Replacements for standard clocks are also illustrated, and a reference chart insures that the correct glass can be ordered. The new line of clock glasses is said to make it easy to service most of the clocks on the market today, and eliminates the necessity of writing to each clock company for individual replacements.

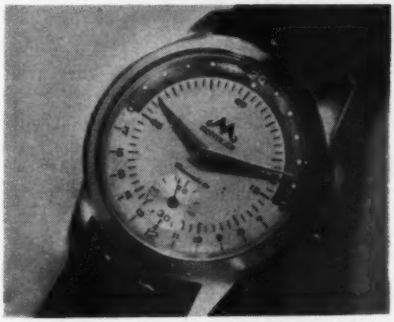
Glasses will be distributed by material dealers. Copies of the new catalog are available from dealers or from the factory at 653 Eleventh Ave., New York 36, N.Y.

## NEW MANUAL ON REPAIR OF OMEGA AUTOMATICS

The correct repair of self-winding watches calls for the most expert craftsmanship. Mistakes are costly and the reputation of both the watchmaker and manufacturer are at stake if the customer is dissatisfied. For this reason Omega has issued a profusely illustrated "how-to-do-it" manual on the proper way to repair Omega automatics. It is one of the most comprehensive technical guides ever issued, covering the latest calibers of Omega atomatics. A copy should be in every watchmaker's reference library.

The manual is available free to readers of the American Horologist & Jeweler. Address your request, on your letterhead, to the Technical Department, Omega Watches, 655 Madison Avenue, New York 22, N. Y.

## NIGHT AND DAY TIMES SHOWN ON DIAL OF 24-HOUR WATCH



A new watch with a 24-hour dial has recently been developed by the Montilier Watch Company of Montilier, Switzerland, the firm announced.

The new watch, which according to the company, prevents any misunderstanding between a.m. and p.m. times, can be used for time-table calculations, programs, military orders, astronomical data, etc.

Night hours are shown on a dark background with luminous points and are differentiated from day times.

The manufacturer states that the watch is ideal for railway, shipping and airway transportation, postal employees, mine engineers, military offices, and in factories working with several shifts.

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**SOUTHERN WATCH COMPANY** **Gray 2, Georgia**

In the future, the company states, it will be a matter of keeping a date fixed at 15.00 hours instead of 3 p.m., or going to a concert beginning at 20.15 hours instead of 8:15 p.m.

## WATCH INSPECTION TIME CONTEST WINNERS

Three members of the staff of The Watchmakers of Switzerland Information Center, 730 Fifth Avenue, New York City, are shown above reviewing entries received in the Watch Inspection Time Contest, which attracted compositions from more than 600 jewelers and watchmakers. They are Paul A. Tschudin, managing director (center); Jean-Pierre Savary (left) and Robert Kaempfer.

Winners of the Sixth Annual Watch Inspection Time Contest, sponsored by The Watchmakers of Switzerland as part of its national Watch Inspection Time program, have been announced by Paul A. Tschudin, Director of The Watchmakers of Switzerland Information Center. The winners and their prizes are:

GRAND PRIZE WINNER—Charles E. Vogel of 15 South Lansdowne Avenue, Lansdowne, Pennsylvania. Awarded a famed black and gold, 29-inch-high Neuchatel clock from the Swiss town of the same name. This valuable Swiss timepiece, Mr. Tschudin said, is a perfect example of Swiss horological craftsmanship, with its pendulum movement that is wound once a week and strikes on the half-hour and hour.

SECOND PRIZE WINNER—Clarence S. Guillet of Guillet's Clock and Appliance Service, 288 Mechanic Street, Southbridge, Massachusetts. Awarded a fully-equipped Swiss staking tool set in a handsome wood box, complete with a wide assortment of precision punches.


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THIRD PRIZE WINNER—Anthony J. Russo of Cyruss Jewelers, 389 Main Street, Beacon, New York. Awarded a fully-equipped Swiss staking tool set in a handsome wood box, complete with a wide assortment of precision punches.

FOURTH PRIZE WINNER—Richard J. Wilson of Syracuse-Henry Jewelry Corporation, 206 Loew Building, Syracuse 2, New York. Awarded a fully-equipped Swiss staking tool set in a handsome wood box, complete with a wide assortment of precision punches.

FIFTH PRIZE WINNER—John F. LeRoy of LeRoy Jewelers, 1522 Broadway, Scottsbluff, Nebraska. Awarded a valuable assortment of fine Swiss hand tools.

SIXTH PRIZE WINNER—Mrs. Lawrence T. O'Rourke of O'Rourke Jewelry, Nauvoo, Illinois. Awarded a valuable assortment of fine Swiss hand tools.

SEVENTH PRIZE WINNER—Chester W. Hoener of Hokamp-Keis, 701 Maine Street, Quincy, Illinois. Awarded a valuable assortment of fine Swiss hand tools.

EIGHTH PRIZE WINNER—Jack Zachary of Lloyd's, Inc., 27 Church Street, Martinsville, Virginia. Awarded a valuable assortment of fine Swiss hand tools.

As a special "surprise," bonus prizes consisting of beautifully-illustrated calendars, especially imported from Switzerland for this event, are being awarded to the first 300 entries received in the competition.

The contest, offered by The Watchmakers of Switzerland for the sixth consecutive year as an aid to bettering jeweler-customer relations, set a new record with entries from more than 600 retail jewelers and watchmakers. Entrants were required to submit an essay on the theme, "I believe a watchmaker is vitally important to the retail jewelry store because . . ."

Grand Prize Winner Vogel completed his contest statement with a 4-point presentation:

"(a) The watch is the jewelry store's most staple item. It follows, then, that the servicing of same is more than an essential element in maintaining a profitable establishment.

"(b) The watchmaker, by his indispensable dexterity in handling fine watches, is a prime factor in concretely perfecting the store's integrity.

"(c) The increase in traffic induced by the necessity for watch repairs cannot be overestimated. The watchmaker is a magnet! Imagine the jewelry store's resultant potential sales on the part of countless, curious "counter shoppers" originally attracted by nothing more than good service!

*"The sale of many a precious gem,*
*Came by way of crown and stem;*
*A staff or jewel replaced with care*
*May sell a diamond solitaire.*

"(d) On its own, a service department of efficient watchmakers can show a handsome profit."

Contest judges, Milton B. Freudenheim, President of the National Wholesale Jewelers Association; Seymour Greenberg, President of the National Jewelers Association; Norman Luth, President of the United Horological Association of America; Eugene Sobel, President of the Watch Material Distributors Association of America; and Howard Schrantz, President of the Horological Institute of America, indicated that the entries show a consistently-high degree of originality of thought and interest in the part the watchmaker plays in the retail jewelry store operation.

The statements made by the prize winners include such points as:

"It is the untiring and relentless efforts of the man at the bench who solves numerous watch problems day-to-day that gives the jewelry store its momentum . . . the watchmaker is the greatest asset any jewelry store could have and he should be looked upon as the very pulse of the organization."

"The store with a watchmaker can promote greater sales of watches because it can back each sales talk with the infinite experience of a man that can make the minor adjustments so numerous and important to the prospective buyer. The consumer *feels* the assurance of service and reliability in the offered product."

"The watchmaker is the diplomat, the mechanic and the salesman all rolled in one. His attitude and approach can be largely responsible for the success or failure of any jeweler."

"Find a store with a good reputation for accurate watch repair service and you will find a successful retail jewelry store."

"The watchmaker heads the department which is able to maintain a stability when other departments are fluctuating with seasonal business."

"Consider the position a watchmaker fills—skilled technician, salesman, merchandiser, public relations man."

When plans for the contest were originally announced, Paul Tschudin declared, "The watch service department not only is profitable on its own but it sparks a great percentage of all sales in the retail jewelry store today. We hope that by

focusing trade attention on the vital importance of the watchmaker to the jewelry store, the part that the man at the bench plays in the store's over-all operation will be more readily recognized."

## TEXAS GOVERNOR ENDORSES "KNOW YOUR JEWELER" PLAN

A proclamation urging the people of Texas to support the "Know Your Jeweler" programs originated by the Watchmakers of Switzerland has been issued by Gov. Allen Shivers.

The declaration was made as three Texas newspapers—the Houston Post, the Dallas Morning News and the San Antonio Light—planned special "Know Your Jeweler" supplements for November 28. The special sections were arranged through the joint efforts of the newspapers, jewelry and horological associations in those cities, and field merchandising representatives of the Watchmakers of Switzerland.

The proclamation called the "jewelry profession and industry an important source of payroll productivity in the state" which "makes a significant contribution to our economy." The decree added:

"Public confidence in the traditional skills, dignity, integrity and dependability of jewelers and watchmakers is being promoted through the "Know Your Jeweler" plan. This plan was developed by the Watchmakers of Switzerland with the aid and encouragement of the American National Retail Jewelers Association, the National Jewelers Association, and Jewelry Industry Council, and the American Watch Association.

"Therefore I, as Governor of Texas, do hereby urge the people of our State to support the 'Know Your Jeweler' plan as a means of furthering the economic benefits which our State derives from this industry."

The "Know Your Jeweler" program is a trade program, working to increase store traffic and profit through the stimulation of more public interest in quality jewelry stores.

---

Times are so tough these days that some jewelers won't even give advice away free any more.

* * *

The only time a jeweler should have the last word with a customer—is when he apologizes.


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# Elgin Claims Approach to Stress-Free Spring; Stud End Is Now Bonded

WATCHMAKING science has taken a major step towards achieving a completely stress-free hairspring that will give tomorrow's jeweled watch consistently better stability of rate.

Elgin National Watch Company, which two years ago discovered a distortion-free method of bonding the spring to its collet, has now been able to adapt the same bonding principle to the stud end.

The result is complete freedom from distortion and stress at both ends of the spring, and what Elgin terms a "promise" that stress will soon be eliminated throughout the entire length of the spring.

At the same time, Elgin has replaced the conventional triangular-shaped hairspring stud with a round stud that "floats" freely in its hole in the balance cock as dictated by pressures exerted on it by the hairspring. A set-screw then locks the stud in position.

Under the old method, the triangular stud had to fit precisely into the triangular hole in the cock at an inflexible angle that frequently produced stress on the spring.

The new stud is made of a light-weight, non-magnetic alloy material that eliminates more than two-thirds of the weight of the old stud, and thereby reduces the danger of hairspring entanglement when the spring is being assembled or cleaned.

In bonding the spring to the stud, Elgin uses exactly the same method announced in 1952 for bonding the collet end, a development that has been hailed as one of the most significant contributions to watch construction in recent years. Practically no bond failures have been reported in the hundreds of thousands of watches manufactured since the new colleting process was adopted.

In both the collet and stud operations it has been possible to abandon the conventional method of pin-anchoring the spring into a hole. This process placed an initial stress on the hairspring by wedging the spring into the hole, and additional stresses beyond the spring's elastic limits were imposed when the collet end of the spring was bent in the now obsolete truing process.

As in the case of the collet, the stud end of the spring is fitted into a slot cut across the lower surface of the stud and fastened into place with a special bonding material.

Just as assembly of the collet end has been controlled so rigidly that the finished product is automatically true in the flat and in the round, so is bonding of the stud end controlled so that the stud emerges automatically true with the hairspring. No pinching and twisting are needed to straighten it.

For the past two years Elgin has been changing its colleting method as rapidly as possible until the new construction is now used in more than 90 per cent of all watches produced. Following the same procedure, the company is already using the stud assembly in all 8/0 men's movements and 20/0 ladies' movements, and will adopt it for other movements as soon as production facilities permit.

---

**The following 16 pages numbered 49-64, make up the fourth sectional insert reprinted from T. D. Wright's great book "Technical Horology."**

**The 114 pages of "Technical Horology" will be presented monthly in the American Horologist & Jeweler in consecutive 16-page insets, numbered as the original book pages are numbered.**

as occupying one-third of the pitch at the pitch circumference, the space occupying two-thirds. These are the usual proportions, and the spaces are shown as usually made. Here, as with the wheel teeth, curved fillets at the roots of the leaves, where

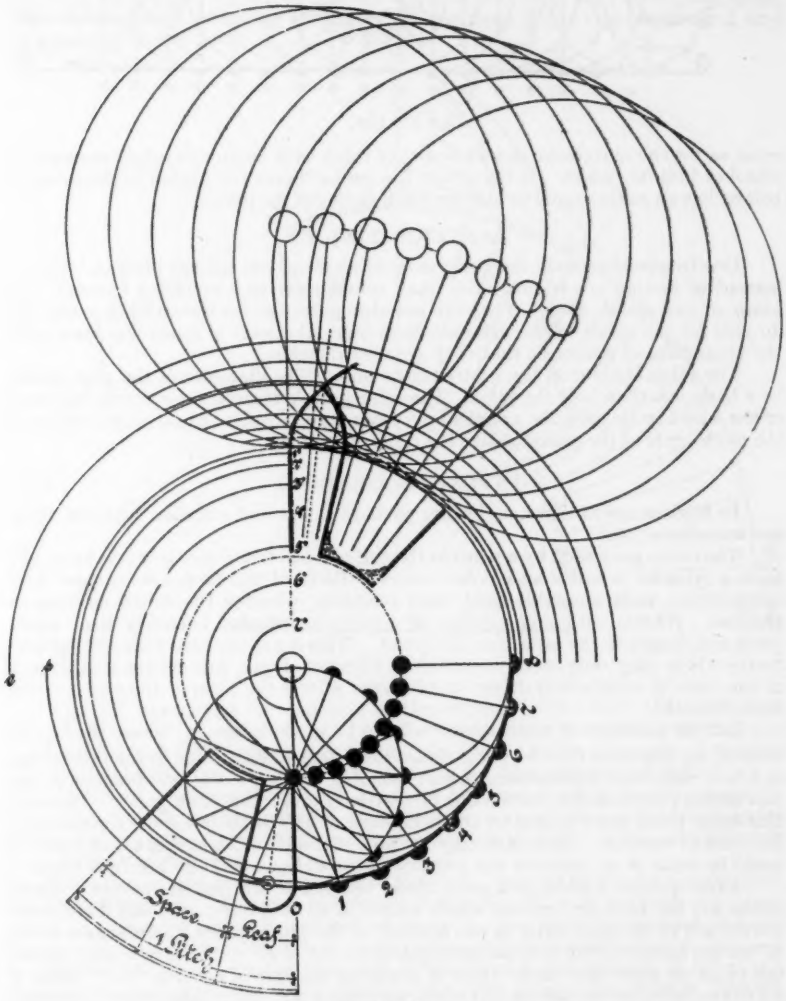


FIG. 13A.

the addenda of the wheel teeth can never enter, would add greatly to the strength of the pinion without altering the *acting* faces in any way.

One leaf is shown with a semi-circular rounding, the semi-circle being struck from the middle of the chord of the arc embraced by the tooth. The higher addendum shown is an epicycloid suitable for the leaf if it had to drive a wheel twice the size of the pinion, the wheel having radial flanks.

Fig. 13B represents a cycloidal curve such as would be used for the teeth of a straight rack intended to drive a pinion. The method of drawing is precisely the

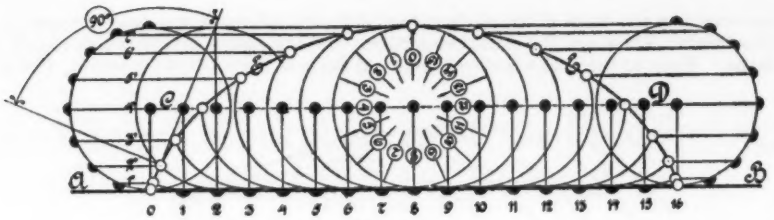

FIG. 13B.

same as for the epicycloid, indeed one may think of it as an epicycloid drawn to a wheel of infinite radius. If the pinion has radial flanks the rolling circle must, as before, have a radius equal to half the pitch radius of the pinion.

## LANTERN PINIONS.

One frequently sees in the going parts of turret-clocks lantern pinions. These, instead of having cut leaves, have small round steel pins mounted between two brass, or gun-metal, discs. They are not strong enough for the striking parts, but do well for the going train. The action is light, the wear is much less than with the usual form of pinion, so that they are very durable.

The pitch circle is in the centre of the pins. The diameter of the pins should be a little less than half the pitch. The rolling circle tracing the epicycloidal faces of the wheel teeth may, for practical purposes, have a radius equal to the radius of the pitch circle of the pinion minus the radius of the pin.

## INVOLUTE GEARING.

In keyless mechanisms, and other parts of clocks and watches, involute teeth are sometimes used.

The curve generated by a point in the end of a stretched string as it is unwound from a cylinder, is called an involute curve. Teeth of this form are stronger than epicycloidal, work smoothly, and work correctly, whether the depth be deep or shallow. Wheels with any number of teeth gear together correctly if of equal pitch and drawn to the same line of contact. This is not the case with epicycloidal teeth, where they only work correctly at a proper depth, and where a difference in the ratio of numbers in driver and follower affects the form of the curve of the face of tooth.

Let the numbers of teeth in two wheels be in the ratio $\frac{3}{1}$. Draw the line of centres, on this draw the two pitch circles to any convenient scale in the proportion of 3 to 1, with their circumferences just touching. Draw a common tangent to the two circles perpendicular to the line of centres through the pitch point. Through this same point draw a line, at an inclination of 15° to the tangent, representing the path of contact. This path may be more inclined to the tangent, but it is not usual to make it so, because the pressure is too oblique and the bearings wear.

Draw a circle within each pitch circle tangent to the line of contact. These circles are the base circles from which we are to unwind our cords, and if correctly drawn, are in the same ratio to one another as the pitch circles, therefore an arc of 60° of the smaller circle is equal in length to an arc of 20° of the larger one. Mark the point on each base circle where it is cut by the line of centres "0." From 0 set out an arc of 60° on the smaller circle, and one of 20° on the larger one. Remembering that these arcs are of equal length, straighten them out and set out the length in a straight line on the side of your drawing as a scale. Suppose the radius of your smaller circle be 3 inches, then the whole circumference $= 3 \times 2 \times 3{\cdot}1416$, and the arc of $60° = \frac{\text{circumference}}{6} = 3{\cdot}1416$ inches $\therefore$ Make your straight line 3·1416 inches long, and mark one end of it 0. Divide your straight line and your two arcs into the same number of equal divisions—the greater the number of divisions the more accurate the result—and number them consecutively from 0, 1, 2, etc. You will notice that the *straight* distances between the marks on the curves are shorter than those on the scale, and those on the small circle are shorter than those on the large one, although they all represent equal distances *along*

*the lines.* At each division on the curves draw tangents to the circles, at the marks, representing the cord straightened out at each point. Take the distance 0-1 on the straight scale, from " 1 " on each arc set out this distance along its tangent, indicating the end of the straightened-out cord. Take the distance 0-2 on straight scale, set this out on the tangents at the 2 of each curve, and so on, join all the points indicating the respective positions of the end of the cord, and you have your involute.

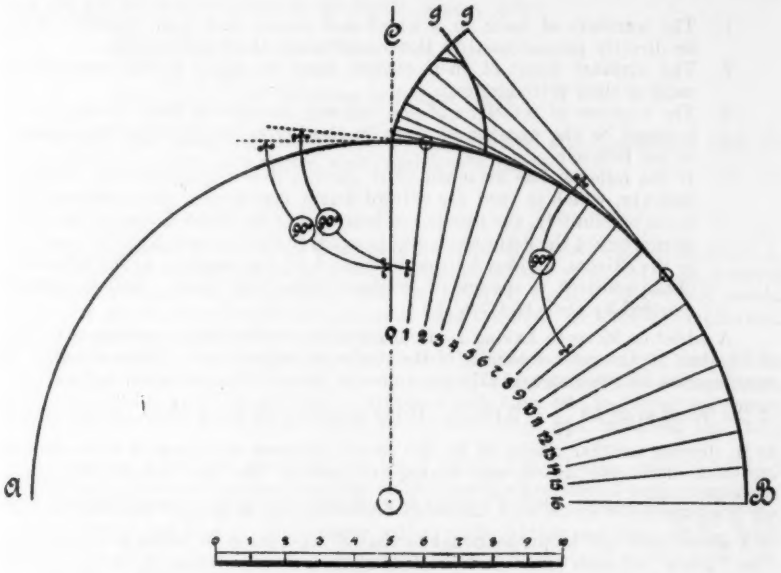


FIG. 13c.

Fig. 13c shows the development of the involute curve from the base circle AB. C is the line of centres from which the curve starts, the arcs of 90° indicate the tangents and their respective radii, and the curve I follows the path of the end of the straightened-out cord as it unwinds from the circumference of AB.

An arc of the circumference of AB is set out in a straight line as a scale for measurement along the tangents at successive stages. The straight distance 0-10 on the scale is equal to the distance, *measured along the arc*, of the circumference from radius 0 to radius 10.

The relative size of the base circle to the pitch circle will depend upon the path of contact selected. The line indicating this path will pass through the pitch point, *i.e.*, the point on the line of centres where the two pitch circles meet, and will pass across both circles. The base circles, within the pitch circles, will be tangent to this line. As already stated, this path is usually at about an angle of 15° to the common tangent of the two pitch circles at the pitch point = an angle of 75° with the line of centres, but it may be at any other required angle.

All wheels gearing together must be constructed to the same path of contact.

There is always some friction between the teeth and leaves in any kind of gearing. That which occurs before the line of centres—as the intersection of the acting points is increasing—is called *engaging friction.* That which occurs after the lines of centres—as the acting points are separating—is called *disengaging friction.* The former is much more detrimental and productive of wear than the latter, so we endeavour to have as little action before the line of centres as possible. In high-numbered trains each tooth has to act through a shorter angular distance, the whole of the contact takes place nearer the line of centres, and a greater proportion of it after than before. With a pinion of 12 the whole of the contact can be from and after the line of centres, and there need be no engaging friction.

High-numbered trains give smoother depths than low numbers, but in cutting a great number of teeth in the same space, each tooth is necessarily smaller and weaker, so there is a limit on account of requisite strength ; with very fine trains, wear of the holes, or slight errors in planting, more easily affect the depth than with wheels of coarser pitch.

## TRAIN CALCULATIONS.

1. The numbers of teeth in a wheel and pinion that gear together must be directly proportional to the diameters of their pitch circles.
2. The distance apart of their centres must be equal to the sum of the radii of their pitch circles.
3. The number of rotations of the follower during one turn of the driver is equal to the number of teeth in the driver, divided by the number in the follower.
4. If the follower has attached to it another driver gearing with a second follower, which in turn has a third driver acting on a third follower and so on indefinitely, the number of rotations of the last follower in the train during one of the first driver, will be equal to the product of all the numbers in the drivers, divided by the product of all the numbers in the followers. (This quotient is spoken of as the "value of a train," and is usually denoted by the letter "e.")

A wheel of 90 teeth having a pitch diameter of 9 inches is to drive a pinion of 10, then (1) the pitch diameter of the pinion must be 1 inch, (2) the distance of centres must be 5 inches, and (3) the number of turns of the pinion during one turn of the wheel must be $\frac{90}{10} = 9$ turns. If the pinion of 10 has a wheel of 80 rivetted to it, driving another pinion of 10, the second follower will make 8 turns during one turn of its own driver, and during one turn of the first driver will make $\frac{90 \times 80}{10 \times 10} = 72$ turns. Rule 1 applies to each pair that gear together, but the size of a wheel need not be proportional to that of the pinion to which it is rivetted. The "pitch" of each pair is independent of the others. When the wheels drive, the speed of each additional driver increases, therefore the force diminishes, and the sizes may decrease, because we shall not need such large and strong teeth to the quicker moving wheels.

The number of turns made by any wheel in a watch or clock train during one turn of any other wheel in the same train may be determined by Rules 3 and 4, care being used to observe that only those wheels and pinions are taken into account which are really in action. For instance, to determine the number of turns of fourth wheel during one turn of centre, one needs only to know the numbers in the centre and third wheels, and the third and fourth pinions, the centre pinion and fourth wheel have nothing to do with that calculation. It is best in solving such questions to roughly sketch the conditions. It prevents mistakes. The number of rotations made by the escape wheel during the whole time of going is equal to the number of turns of the great wheel multiplied by the product of all the wheels (except the escape wheel itself) divided by the product of all the pinions (escape pinion included). The number of vibrations made by the balance or pendulum during one turn of the escape wheel is equal to twice the number of teeth in the escape wheel, because each tooth gives two vibrations, one in each direction.

The centre wheel usually makes one turn in an hour (one hour of the watch's own showing, not necessarily an hour of true time unless the watch is going to time), so most trains are calculated from the centre wheel. If it be a "seconds train" then the fourth wheel must make 60 turns to one of the centre, and the following conditions must be fulfilled :—

$$\frac{\text{Centre teeth} \times \text{third teeth}}{\text{third leaves} \times \text{fourth leaves}} = 60.$$

If any three of the numbers are given you can determine the other, if two are given you can determine the ratio that must be between the other two.

For instance, the centre wheel of a seconds train watch has 80 teeth, the third and fourth pinions have 10 leaves each, how many teeth has the third wheel?

$$\frac{80 \times x}{10 \times 10} = 60 \therefore 80 \times x = 60 \times 10 \times 10$$

$$x = \frac{60 \times 10 \times 10}{80} = 75 \text{ teeth in third wheel.}$$

Or suppose you knew the numbers in the two wheels and in the third pinion but did not know the number in the fourth pinion, then:

$$\frac{80 \times 75}{10 \times x} = 60 \therefore 80 \times 75 = 60 \times 10 \times x.$$

$$x = \frac{80 \times 75}{60 \times 10} = 10 \text{ leaves in fourth pinion.}$$

Or suppose you know the numbers in the third wheel and pinion and wish to determine the numbers in centre wheel and fourth pinion:

$$\frac{x \times 75}{10 \times y} = 60, \quad \frac{x}{y} = \frac{60 \times 10}{75} = \frac{8}{1}$$

The number in centre wheel must be to the number in fourth pinion as 8 is to 1.

A wheel of 48 and pinion of 6, or a wheel of 56 and pinion of 7, or a wheel of 64 and pinion of 8, would each fulfil the required conditions, but you would obviously select a wheel of 80 and pinion of 10 as the most suitable in combination with the existing third wheel and pinion.

The number of vibrations made by the balance or pendulum during one turn of the centre wheel (that is, in one hour, if the watch or clock is going to time), is equal to *twice* the product of all the wheels from and including the centre wheel, divided by the product of all the pinions from and including the third pinion.

A centre wheel has 64 teeth, the third pinion has 8 leaves, the third wheel has 60 teeth, the fourth pinion has 8 leaves, the fourth wheel has 63 teeth, the escape pinion has 7 leaves, the escape wheel has 15 teeth. How many vibrations will the balance make per hour? How many will it make during one turn of the third wheel?

(*a*) $\frac{64 \times 60 \times 63 \times 15 \times 2}{8 \times 8 \times 7} = 16{,}200$ vibrations per hour.

(*b*) $\frac{60 \times 63 \times 15 \times 2}{8 \times 7} = 2{,}025$ vibrations during one of 3rd wheel.

The escape pinion of a clock makes $3\frac{3}{4}$ turns per minute. How many teeth will the escape wheel require in order that the pendulum may make three single vibrations per second?

$3 \times 60 = 180$ vibrations of pendulum per minute, during which time wheel makes $3\frac{3}{4}$ turns, during one turn of wheel there will be $180 \div 3\frac{3}{4}$ vibrations $= \frac{180 \times 4}{15} = 48$, and as each tooth gives two vibrations the wheel must have $\frac{48}{2} = 24$ teeth.

The fourth wheel and pinion of a seconds train lever watch has been lost. It is found by counting the free vibrations of the balance and spring that it was a "16,200 train." The centre wheel has 80 teeth, the third wheel 60, the escape wheel 15, the third pinion has 10 leaves, the escape pinion 7. Determine the numbers in the missing wheel and pinion.

It is a seconds train, therefore:—

$$\frac{80 \times 60}{10 \times x} = 60 \therefore x = \frac{80 \times 60}{60 \times 10} = 8 \text{ leaves in fourth pinion.}$$

$$\text{then} \frac{80 \times 60 \times x \times 30}{10 \times 8 \times 7} = 16{,}200.$$

$$\text{then } x = \frac{16{,}200 \times 10 \times 8 \times 7}{80 \times 60 \times 30} = 63 \text{ teeth in fourth wheel.}$$

A lever watch has the following train :—

| | | | |
|---|---|---|---|
| Centre wheel | 64 teeth. | | |
| Third | ,, 60 ,, | Third pinion, | 8 leaves. |
| Fourth | ,, 70 ,, | Fourth ,, | 8 ,, |
| Escape | ,, 15 ,, | Escape ,, | 7 ,, |

and is observed to gain one minute per hour. What modification would you make in order to regulate it—(1) by altering the train while the number of vibrations is maintained the same, and (2) by altering the number of vibrations while the train is unaltered ?

(1) $\frac{64 \times 60 \times 70 \times 30}{8 \times 8 \times 7} = 18{,}000$ = vibrations of balance during one turn of centre wheel.

The watch is gaining one minute per hour, therefore the centre wheel is making $1\frac{1}{60}$ turns per hour, and in one hour of true time the balance will make 18,300 vibrations. If we alter the train so that the centre wheel makes one exact rotation while the balance makes 18,300 vibrations, the hands will show true time without in any way altering the rate of vibration of balance. As at present arranged it is a seconds train. It is not desirable to alter that condition, nor is it desirable to alter the number of teeth in escape wheel if that can be avoided. Can we satisfy the question by fitting a new fourth wheel or a new escape pinion, or both. Let us try.

$$\frac{64 \times 60 \times x \times 30}{8 \times 8 \times y} = 18.300 \therefore \frac{x}{y} = \frac{18{,}300 \times 8 \times 8}{64 \times 60 \times 30} = \frac{61}{6}$$

A new fourth wheel of 61 teeth and a new escape pinion of 6 must be substituted and the watch will be " to time." This is not intended to suggest a practical method of regulating a watch, but merely as a test of ability to calculate a train.

(2) Lengthen the balance spring by letting it out at the stud, or if it be a compensation balance, add two small screws, or substitute heavier ones, or if necessary apply a weaker balance spring.

A certain watch has a fourth wheel with 60 teeth, and is going correctly. How much would the hands lose or gain if the wheel had (*a*) 64 teeth, (*b*) 56 teeth ? As the watch was going correctly, 60 teeth of the fourth wheel will advance in the proper time, whatever number it may have.

With 64 teeth the wheel would only make $\frac{60}{64} = \frac{15}{16}$ of a turn during the time it should have made a complete turn ; it will therefore be 1-16th of a turn behind, and at the end of any interval it will be 1-16th slow. It would lose $1\frac{1}{2}$ hours per day. With 56 teeth it will make $\frac{60}{56} = 1\frac{1}{14}$ turns, and will be 1-14th fast. It would gain 1 hr. $42\frac{6}{7}$ min. per day.

An eight-day clock with a seconds pendulum and a seconds hand has pinions of 12 throughout. The barrel makes 16 turns. Find the numbers of teeth in the wheels. As it has a seconds pendulum, and the escape wheel advances a whole space in two vibrations, the escape wheel must have 30 teeth.

The centre pinion has 12 leaves, and makes $24 \times 8$ turns in 8 days, during which time the great wheel makes 16 turns $\therefore \frac{12 \times 24 \times 8}{16} = 144$. The great wheel must have 144 teeth.

The escape wheel has to make 60 turns during one turn of the centre wheel. Let C = number of teeth in centre wheel, and T = number in third wheel.

$\frac{C \times T}{12 \times 12} = 60 \therefore CT = 60 \times 12 \times 12$. These numbers may be reduced to their prime factors, and the numbers for the wheel teeth built up with the factors in any convenient proportion so long as all the factors are used, and the product of C. T. = 8,640. The usual division is to make C = 96 and T = 90.

A watch with an escape wheel of 15 teeth is going to time when a tooth is broken out so that one tooth misses the pallets altogether. What error will this cause in the time recorded by the hands ?

(1) If it has cylinder escapement.

(2) If it is a lever.

(1) The one tooth of the escape wheel will miss both lips of the cylinder, but all the other teeth will act properly. At the end of fourteen double beats the wheel will have turned completely round and the hands will have recorded fifteen.

In fourteen minutes the hands will record fifteen, and the gain during any number of turns of the wheel will be one in every fourteen. The daily gain will equal $\frac{24}{14} = 1\frac{5}{7}$ hours.

(2) With the lever escapement the gain will be much greater, because, not only does the broken tooth miss both pallets, but one of the good teeth misses each pallet. When the big drop occurs the wheel advances a whole space because the other pallet which should have been in position at the half-space to receive another tooth is at the wrong banking and allows it to pass. The wheel has only thirteen acting teeth, at the end of thirteen minutes the hands will record fifteen, and the gain during any number of complete turns of the wheel will be two in every thirteen. The daily gain will equal $\frac{24 \times 2}{13} = 3\frac{9}{13}$ hours.

In any of the usual forms of clock escapements the same result would be obtained. The one missing tooth would cause one good tooth to miss at each pallet, and the wheel, in effect, has two teeth missing.

Up-and-down trains for fusee watches and chronometers are, usually, very simple calculations. A pinion of fairly high number, so that the heart may have a sound hole drilled in the centre, is fitted on to a reduced part of the lower fusee pivot projecting through the pillar-plate, under the dial. This pinion gears with the up-and-down wheel, the arbor of which carries the up-and-down hand. The hand must make something less than a complete turn or we should not know whether it indicated "up" or "down." It may make half-a-turn or three-quarters, four-fifths, five-sixths, seven-eighths, etc. The number of leaves in the pinion on the fusee pivot, multiplied by the number of turns the fusee makes, must equal the number of teeth of the wheel representing the fraction of its full number that the hand is to turn through.

The hand is to describe six-sevenths of a turn, the fusee makes four turns and has a pinion of twelve fitted to it. How many teeth must the wheel have?

$12 \times 4 = \frac{6}{7}$ths of $x$. $x = \frac{12 \times 4 \times 7}{6} = 56$ teeth.

In a two-day marine chronometer the fusee makes eight turns. The up-and-down hand describes four-fifths of a circle. How many teeth have the wheel and pinion?

Let W = number in wheel and p = number in pinion.

$$8\,p = \frac{4\,W}{5}, \quad \frac{W}{p} = \frac{8 \times 5}{4} = \frac{10}{1} = \frac{100}{10} = \frac{120}{12} \text{ etc.}$$

The distance apart of the centres of a driver and its follower must be equal to the sum of the radii of their pitch circles. The radii will vary directly as the number of teeth. A wheel of 64 drives a pinion of 8, their centres are 1 inch apart. Determine the pitch diameters of the wheel and pinion.

The distance of centres must be divided into two parts in the same proportion as the numbers in the wheel and pinion, the larger part will then be equal to the radius of pitch circle of the wheel, and the smaller part to the radius of pitch circle of pinion; Diameter = twice the radius.

$$\frac{1}{64 + 8} \times 64 \times 2 = 1\frac{7}{9} \text{ inches} = \text{diameter of wheel.}$$

$$\frac{1}{64 + 8} \times 8 \times 2 = \frac{2}{9} \text{ inches} = \text{diameter of pinion.}$$

It is sometimes necessary, as in the motion works of turret clocks, and in the winding works of keyless watches, to transmit motion from one wheel to another which, instead of being in the same plane, is at right angles to the driver. This is usually best done by bevel wheels. When the two wheels have equal numbers of teeth the bevels are at equal angles, each pitch surface forming an angle of 45° with the axis, they are then called mitre wheels; this is the usual form for the bevels in the nests of turret clocks.

When the wheels have unlike numbers of teeth, the angles are no longer 45°. Suppose a wheel of 40 is driven by a pinion of 10, and that the largest diameters of the bevels are in the proportion of 4 to 1, the pitch of each at that point will be the same, and they will gear together properly, but if the slope of each bevel is at an angle of 45°, the diameter of pinion will decrease very rapidly,

and that of the wheel very little, we should soon reach a point where the reduced diameters were in the proportion of 6 or 7 to 1, the teeth on the pinion would be too close together, and they would not work with the wheel. In all bevels, for the pair to be of equal pitch and act properly together throughout their length, their pitch surfaces must be at such angles that they form parts of two cones, which if continued would meet at their points. At every point of contact the diameters will then be in the same proportion to one another. To correctly draw the slopes draw two lines at right angles to one another, the lengths of the lines being in the same proportion as the required numbers of teeth. Through the middle of each

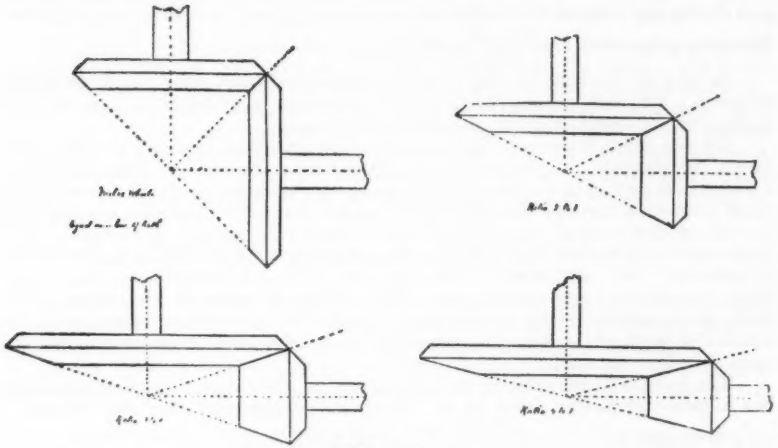

FIG. 14.

line draw one perpendicular to it representing the axis of each, produce these axes until they meet, from the point where they meet to the point of junction of the two first lines forming the right angle draw a line, this last line gives the correct angle of the pitch surface of both wheel and pinion.

The greater the difference in the numbers of teeth the more undercut the wheel will become, and the more the pinion will approach in form to an ordinary spur pinion. If we imagine an infinite increase in the number of teeth in the wheel the pinion would become a spur pinion, and the wheel would be a contrate wheel, with teeth at right angles to its plane.

## EPICYCLIC TRAINS

When a wheel gearing with another not only turns on its centre, but also revolves round the one it gears with, the " value of the train " is modified according to the direction and speed of revolution. Such a train is called an epicyclic train. The Karrusel watch, designed by B. Bonniksen, has a train of this kind. Breguet invented the Tourbillon for the purpose of eliminating, or neutralizing, the variations in the rates of a watch in the different vertical positions, by placing the escapement in a rotary carriage mounted on the fourth, or seconds, pinion ; so that in the course of one minute the balance occupies every possible vertical position, and the watch records the mean vertical rate at the end of every minute. The invention successfully achieved its purpose, but, being costly and delicate, was not generally used. Probably more Breguet Tourbillons have been made since the invention of the Karrusel than were ever made in the many years that elapsed between the two designs. In the Karrusel the rotary carriage turns on a large independent pivot at a much slower rate, usually something less than one hour, the equalization of the vertical rates is obtained at longer intervals, but in a very large degree the same object is attained, and the very practical advantage is gained that the watch is as strong as an ordinary watch, and the extra cost a mere trifle.

Let $C$ = the number of teeth in centre wheel.
" $T$ = " " third "
" $F$ = " " fourth "
" $S$ = " " escape "
" $t$ = " " third pinion.
" $f$ = " " fourth "
" $s$ = " " escape "
" $K$ = " " carriage wheel.
" $k$ = " " pinion driving carriage.
" N = number of rotations of carriage per hour.

In the ordinary watch the number of balance vibrations per hour $= \frac{2\,C\,T\,F\,S}{t\,f\,s}$

In Breguet's original tourbillon, the carriage rotates with the fourth pinion, the fourth wheel is *fixed* to the movement, and the escape pinion, gearing with it, runs in a potence attached to the carriage, so that the motion of the carriage round the fixed wheel produces the same effect as in the ordinary way, and vibrations per hour here also $= \frac{2\,C\,T\,F\,S}{t\,f\,s}$; but when fourth wheel rotates, and carriage turns about same centre, the effect is modified.

If the carriage turns the same way as the fourth wheel the escape pinion is being carried in advance of the wheel, and is not turned so frequently as it would be if its axis of rotation were not being moved round the fourth wheel. If the carriage turned as quickly as the fourth wheel the escape pinion would run round with the wheel, and would not turn on its axis at all, no impulse would reach the balance, and the watch would just run down. If, on the contrary, the carriage turned the opposite way to the fourth wheel, every turn of the carriage would produce the same effect as if the fourth wheel had made an extra turn.

For every turn of the carriage we lose, or gain, the effect of one turn of the wheel F, which drives the escape pinion.

Consequently, the number of vibrations made by the balance in one hour equals

$$\frac{2\,C\,T\,F\,S}{t\,f\,s} \pm \frac{2\,N\,F\,S}{s}$$

N, as already stated, being the number of rotations made by the carriage in one hour.

When the carriage turns the opposite way to $F$, the sign will be $+$.

When it turns the same way as $F$, the sign will be $-$.

If it be a seconds train, as most watches are, with $F$ making one turn per minute, then always $\frac{C\,T}{t\,f} = 60$, and as an escape wheel of 15 is almost invariably used, we may substitute these numerical values in the expression,

$$\text{Vibrations per hour} = \frac{(60 \times 2 \times 15\,F) \pm (2 \times 15\,N\,F)}{s} = \frac{1800\,F \pm 30\,NF}{s}.$$

The trains in common use are those in which the balance makes 14,400, 16,200, or 18,000 vibrations per hour; sometimes a faster train making 21,600 vibrations is employed (6 per second). As each of these numbers, and each term in the formula, will divide by 30, we can simplify the expression when we wish to determine the relative values of $N$, $F$, and $s$.

For a 14,400 train, $60\,F \pm N\,F$, or $(60 \pm N)\,F = 480\,s.$
" 16,000 " do. do. $= 540\,s.$
" 18,000 " do. do. $= 600\,s.$
" 21,600 " do. do. $= 720\,s.$

In these last expressions, as we have divided the vibrations per hour by 30, the numbers 480, etc., give the vibrations in 2 minutes.

Let $V$ = the number of vibrations in 2 minutes.

$$(60 \pm N)\,F = V\,s. \qquad F = \frac{V\,s}{60 \pm N}.$$

When the carriage turns the opposite way to $F$, and sign is $+$,

$$F = \frac{Vs}{60 + N}, \quad N = \frac{Vs - 60\,F}{F}, \quad s = \frac{(60 + N)\,F}{V}, \quad V = \frac{(60 + N)\,F}{s}$$

When the carriage turns the same way as F, and sign is —

$$F = \frac{Vs}{60 - N}, \quad N = \frac{60\,F - Vs}{F}, \quad s = \frac{(60 - N)\,F}{V}, \quad V = \frac{(60 - N)\,F}{s}$$

$V \times 30$ = number of vibrations of balance per hour.

In all Karrusel trains $k$ is on the third arbor, so that $\frac{C}{t}$ = number of turns of $k$ per hour, and $N = \frac{C\,k}{t\,K}$. When $t$, the third pinion itself, is used to drive the carriage, or when $k = t$, then $N = \frac{C}{K}$.

As in all usual trains, $\frac{C}{t} = 8$, $N = \frac{8\,k}{K}$, $\frac{k}{K} = \frac{N}{8}$, $K = \frac{8\,k}{N}$

The time taken by carriage to make one rotation = $\frac{1}{N}$, or the time in minutes = $\frac{60}{N}$

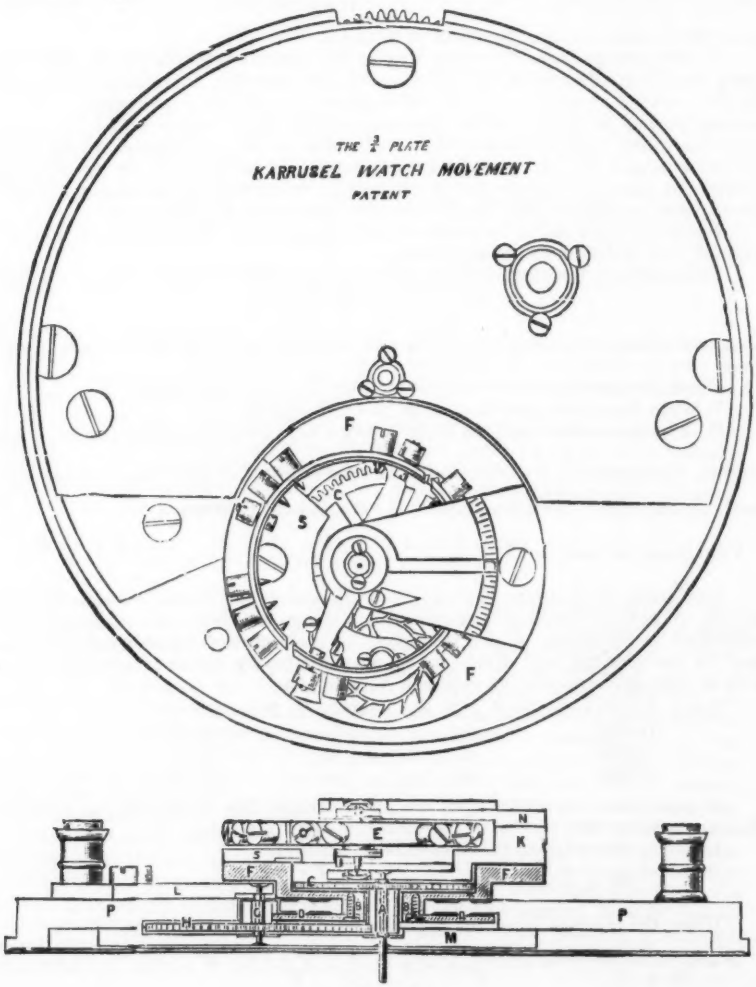


Fig. 15.

In the foregoing formulæ the initial letters of the conventional names of the wheels and pinions are used to indicate them respectively, as $C$ for centre, $T$ for third, etc. $S$ is used for the escape, because it is commonly spoken of as the 'scape wheel, and the letter $e$ might be confused with the letter $e$ generally employed to denote the "value of a train." Carriage is spelt with a $K$, so that it should not be confused with the $C$ for centre.

In Fig. 15, which Mr. Bonniksen was good enough to lend me a block for, the letters do not indicate the same parts as in the formulæ.

$F$ in the fig. is the rotary carriage; $B$ is the boss, or large pivot of the carriage, turning in a hole in the pillar plate, $P$, and having the carriage wheel, $D$, screwed to it, so that the carriage just turns freely, without any unnecessary endshake, the wheel $D$ and the underside of the carriage forming the two bearings; $A$ is the fourth pinion; $C$ the fourth wheel; $G$ the third pinion driving the carriage wheel direct; $H$ the third wheel; $M$ the bar carrying the third and fourth lower pivots; $L$ the cock for third top pivot; $S$ the escape cock; $K$ the potence screwed to carriage and carrying the lower balance and top fourth pivots; $E$ the balance; $N$ the balance cock.

In using the formulæ for determining the values of $F$, $N$, $K$, $k$, $s$, or $V$ we note that $V$ and $N$ are to some extent arbitrary. We may have any number of vibrations per hour we please, but usually one of the four trains mentioned is selected, and the most popular in modern watches is the 18,000 train, measuring fifths of a second, with $V = 600$.

$N$ may be a large number with the carriage making many turns per hour, or it may be a fraction, with the carriage taking more than an hour to make one turn. In the first case the object of the invention is more perfectly attained, as each turn of the carriage neutralizes the differences in the vertical rates, but the mechanism is costly and delicate. When the carriage turns more slowly the elimination of the error *per turn* is as perfect, the net result is nearly as good, and the mechanism may be almost as inexpensive and strong as an ordinary watch. We also note that $F$ and $s$ must be whole numbers; we cannot have fractions of teeth in wheels and pinions. For this reason, train questions should be worked by vulgar fractions, and not by decimals, as the former admit of *exact* results, whereas the neglected portion of a long decimal would entirely spoil the solution.

In the original Karrusel the fourth wheel has 70 teeth, the carriage wheel has 70 teeth, the third pinion drives the carriage wheel, has 10 leaves, and, as usual, makes 8 turns per hour, or one turn in $7\frac{1}{2}$ minutes. During 7 turns, or $52\frac{1}{2}$ minutes it will cause the carriage to make a complete rotation, and in one hour carriage will make $\frac{8}{7}$ turns; or by the formula $N = \frac{8k}{K} = \frac{8 \times 10}{70} = \frac{8}{7}$.

Vib. per hour $= \frac{1{,}800\ F - 30\ N\ F}{s} = \frac{1{,}800 \times 70 - 30 \times \frac{8}{7} \times 70}{7} = 17{,}657{\cdot}1.$

The seconds hand does not exactly record fifths of a second, but the difference is so slight as to be unnoticeable. ($V = \frac{(60 - \frac{8}{7})\ 70}{7} = 588{\cdot}57$ instead of 600).

In the centre seconds Karrusel the carriage wheel has 136 teeth, and is driven by a wheel of 30 fitted on the third arbor. $N = \frac{8 \times 30}{136} = \frac{30}{17}$, and the time of one rotation of carriage = 34 minutes.

The fourth wheel proper, carrying the seconds hand, is, of course, in the centre of the watch, turning the same way as the carriage, but a duplicate of it, mounted on a plain arbor in the centre of the carriage drives the escape pinion, and becomes the $F$ for epicyclic calculations. On the plain arbor outside the carriage, is another duplicate $F$ gearing with, and driven by, the fourth wheel itself, so that the $F$ in the carriage turns the opposite way, and $V = \frac{(60 + N)\ F}{s}$.

The three fourth wheels have 68 teeth each, and $s$ has 7.

$$V = \frac{(60 + \frac{30}{17})\ 68}{7} = \frac{1{,}050 \times 68}{17 \times 7} = 600. \quad \text{(An 18,000 train.)}$$

The chronograph Karrusel has a carriage wheel of 82 driven by a pinion of 15 on the third arbor. $N = \frac{8 \times 15}{82} = \frac{60}{41}$, and carriage makes one turn in 41 minutes.

The fourth wheel of 82, carrying the small seconds hand, is in centre of carriage, so that carriage and $F$ turn the same way. $s$ has 8 leaves.

$$V = \frac{(60 - N)\,F}{s} = \frac{(60 - \frac{1}{4}\frac{0}{0})\,82}{8} = \frac{2{,}400 \times 82}{41 \times 8} = 600.$$

A train appealing to methodical minds would be one with the balance making 18,000 vibrations per hour, and the carriage making one exact turn per hour ($N = 1$). Is it possible to devise one? Let carriage turn same way as $F$.

$Vs = (60 - N)\,F$, $\frac{V}{60 - N} = \frac{F}{s} = \frac{600}{59}$. As 59 is a prime number, the smallest possible escape pinion would require 59 teeth, and it is impracticable. If the carriage turned once in half-an-hour, and $N = 2$, the smallest number for the escape pinion would be 29. If the carriage turned the opposite way to $F$ in one hour, or half-an-hour, the smallest values for $s$ would be 61 and 31 respectively. Although $N$ cannot be either 1 or 2, there may be workable values for $N$ between 1 and 2.

Take an 18,000 train with carriage turning same way as $F$, and $s = 7$.

To turn once an hour $F = \frac{600 \times 7}{60 - 1} = \frac{4{,}200}{59} = 71{\cdot}18$.

$F$ must have more than 71 teeth if $N = 1$.

To turn twice an hour $F = \frac{600 \times 7}{60 - 2} = \frac{4{,}200}{58} = 72{\cdot}4$.

$F$ must have less than 73 teeth if $N = 2$.

The only possible $F = 72$. $N = \frac{60\,F - Vs}{F}$.

$N = \frac{60 \times 72 - 600 \times 7}{72} = \frac{120}{72} = \frac{5}{3}$. Time of one turn = 36 minutes, $\frac{k}{K} = \frac{N}{8} = \frac{5}{3 \times 8} = \frac{10}{48}$. The third pinion of 10 could drive a carriage wheel of 48.

Now assume that $s$ had 8 leaves instead of 7.

To turn once an hour $F = \frac{600 \times 8}{60 - 1} = \frac{4{,}800}{59} = 81{\cdot}3$.

$F$ must have more than 81 teeth if $N = 1$.

To turn once in half-an-hour $= \frac{600 \times 8}{60 - 2} = \frac{4{,}800}{58} = 82{\cdot}7$

$F$ must have less than 83 teeth if $N = 2$ $\therefore$ $F = 82$.

$N = \frac{60 \times 82 - 600 \times 8}{82} = \frac{120}{82} = \frac{60}{41}$. Time of one turn of carriage = 41 minutes.

$\frac{k}{K} = \frac{N}{8} = \frac{60}{41 \times 8} = \frac{15}{82}$. A pinion of 15 on third arbor driving a carriage wheel of 82 would do.

Suppose you have to construct a Karrusel to show quarter-seconds (14,400 train), carriage to turn same way as fourth wheel, and make one turn in a quarter of an hour (then $N = 4$), escape pinion to have 7 leaves.

$$F = \frac{480 \times 7}{60 - 4} = \frac{480 \times 7}{56} = 60 \text{ teeth.}$$

$N = \frac{8\,k}{K}$ $\therefore$ $\frac{k}{K} = \frac{N}{8} = \frac{4}{8}$, so that a pinion, or wheel, of any convenient number on the third arbor, driving a carriage wheel of twice the number, will give the required number of vibrations if the fourth wheel has 60 teeth.

Now let the carriage turn the opposite way and an escape pinion of 8 be used.

$$F = \frac{480 \times 8}{60 + 4} = \frac{480 \times 8}{64} = 60 \text{ teeth.}$$

With the same number in fourth wheel and the same $\frac{k}{K}$ we obtain the required number of vibrations. In this last case an intermediate wheel of any convenient number must be interposed between $k$ and $K$ to reverse the direction of rotation of carriage.

## MEASURING GAUGES.

Various kinds of gauges are used by watch and clock makers, from the plain piece of brass with a notch or step filed in it, to the micrometer, and vernier slide gauges. They may be divided into three classes. (1) Those which merely give copies of the dimensions or form of some piece of work that is to be reproduced. This class would embrace templates and patterns of all kinds, as well as the pieces of notched brass. (2) Gauges which give comparative measurements only, such as pinion gauges, pinion-height and cylinder-height gauges, callipers, &c. (3) Tools which give definite measurements expressed in parts of a recognised standard, as the inch or millimetre. This class includes such tools as the slide gauge, straight-edges with fractions of the inch or millimetre engraved along their edges or across their width, and hole and wire gauges with the diameters numbered in standard measurements.

FIG. 16.

A douzieme gauge, or a dizieme gauge as usually made, although it professes to give definite measurements, belongs rather to class 2. So also do some of the micrometer gauges. The douzieme gauge is very useful for measuring the thickness and depth of sinks and plates, but it is not so good as a slide gauge. It has two limbs pivoted together with the centre closer to one end. The short end terminates in two jaws which embrace the work to be gauged. To the long end of one of the limbs is fixed a scale, and the long end of the other terminates in a pointer, so that the size of any object in the jaws is exaggerated on the scale. The limbs do not cross like a pair of scissors. The long and short legs on either side are in one piece, so that as the jaws open the long legs approach one another.

In any measuring instrument opening about a centre and having the divisions marked at equal distances round a circular arc, there is an inherent fault rendering it useless for proportional measurements. The distance measured is a straight line between the two points, it is the chord of the arc described, and a chord does not vary in the same proportion as its arc. Some douzieme gauges have the divisions marked at unequal distances round the circular arc, so that the numbers correspond with equal straight distances between the measuring points, but those in ordinary use are not so divided, and on such gauges the divisions are not proportional. For instance 48 douziemes is less than 12 times 4 douziemes. Nevertheless the tool is exceedingly useful in many ways for determining equalities of measurements. The ordinary dial micrometer gauge has the same fault, but in a less degree, because the whole arc described by the measuring jaws is usually very small.

The unit on the douzieme gauge = $\frac{1}{12}$ of a French line.

The unit on the dizieme gauge = $\frac{1}{10}$ of a French line.

## VERNIER SLIDE GAUGE.

Very minute divisions cannot be directly engraved on a measuring tool because the necessary width of the lines would exceed the spaces. With a vernier slide very minute measurements may be made, although the divisions employed be comparatively large. The principle of its construction is to divide the fixed part of the tool into any convenient number of equal divisions, and to fix to it one of the chops between which the object to be measured is placed. The other chop is fixed to a slide on which are engraved a number of divisions, *differing in width* from those on the fixed part of the tool, by any required small fraction. When the chops are closed the reading is 0. As the slide is opened, carrying with it the movable chop, the distance of motion apart of the two chops will be indicated by a step-by-step agreement of the division lines on the tool itself with those at a different distance apart on the slide.

If the difference in the width of the two sets of divisions is one-thousandth of an inch, then when the chops are separated by that amount the division 1 on the slide will be exactly opposite division 1 on the fixed part of the tool, when separated by two one-thousandths of an inch division 2 on the slide will coincide with division 2 on the tool, and so on, each successive mark on the slide coming into agreement with the next division on the tool, until the chops are separated by a quantity equal to the distance apart of the main divisions on the tool, then the 0 on the slide will agree with the first division line on the tool, and the last mark on the slide will agree with the same numbered mark on the tool; continuing to open the tool, all the divisions on the slide will again successively agree with the main divisions until the chops are separated by two whole divisions, and so on throughout.

We therefore read the measurement by first noting the number of main divisions that the 0 of the slide has passed, and then determine the fractional part by noting which division on the vernier scale is exactly opposite one of the main divisions.

For instance, suppose the main divisions are tenths of an inch, and that we take nine of those tenths divided into ten equal parts for the slide, each division on the slide will be narrower than the main divisions by the tenth of a tenth—that is by one-hundredth of an inch. If we then open the tool one-hundredth of an inch, the first division on the slide will come opposite 1 on the tool, if we open it another one-hundredth the second division on the slide will be opposite the second division on the tool, continuing to open it we shall find that each mark along the slide will in succession come opposite a division on the tool until the chops are opened one-tenth of an inch, when the tenth and last division on the slide will be opposite the tenth division on the tool, and the 0 mark on the slide will be opposite the mark 1 on the tool, opening still further, each mark on the slide will again successively agree with a mark on the tool until the second division is reached and so on.

To measure to the one-thousandth of an inch two methods of dividing are employed.

The best way is to divide the main part of the tool into tenths and fiftieths of an inch. Nineteen fiftieths are then divided into 20 equal parts on the slide, so that each of these narrower divisions is less than the main divisions by the twentieth of a fiftieth of an inch. That is, the divisions on the slide are narrower than the divisions on the tool by the one-thousandth of an inch. As the tool is opened, each of the divisions along the slide successively agrees with a division on the tool. To read a measurement you note, first, the number of inches, tenths, and fiftieths that the zero mark on the slide has passed, and then read along the twenty divisions on the slide to the one that is exactly opposite a mark on the tool, the number on the slide at this point will give the number of thousandths to be added. In setting the answer down in decimals you take each fiftieth = ·02.

The other method used is to divide the tool into tenths and fortieths. Twenty-four fortieths are then divided into 25 equal parts for the vernier, and again we have the divisions on the slide narrower than those on the tool by one-thousandth of an inch. The advantage of this method is that the divisions are wider apart, but the reading of the fractional parts is much more confusing, and as fiftieths are quite wide enough for clear and easy reading the method first given is preferable. The easiest tool to read would be one with the main scale divided into hundredths,

nine of these being divided into ten equal parts for the vernier, but the divisions would then be too close to be easily seen.

When the metrical system of measurement is employed the main divisions are centimetres, millimetres and half-millimetres, twenty-four half-millimetres are divided into 25 equal parts for the vernier scale on the slide, and the difference between the divisions on the tool, and those on the slide, is one twenty-fifth of a half-millimetre = one fiftieth of a millimetre = about $\frac{1}{1270}$ of an inch.

In reading, the millimetres and half-millimetres are read direct, and the odd fiftieths read along the vernier scale on the slide.

Other divisions may be used to measure the same fractions, or the tool may be divided to measure any other fractions, but in all of them the principle is the same, the difference between the width of the two sets of divisions is equal to the small fraction to which the tool is to measure.

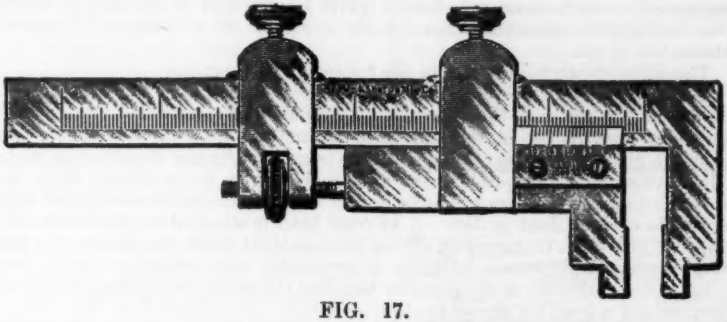

FIG. 17.

Fig. 17 is an illustration of Brown & Sharpe's vernier slide gauge such as I use. It is divided into tenths and fiftieths of an inch with the vernier reading to one thousandth as explained. The reverse is divided into millimetres, etc., as described.

Care must be used in reading a slide gauge as it is easy to make a mistake. A micrometer gauge, called the Cicerimet, invented and manufactured by Mr. Ciceri Smith does not encourage mistakes. Fig. 18 is an illustration of one of these gauges (No. 8), recording thousandths of an inch.

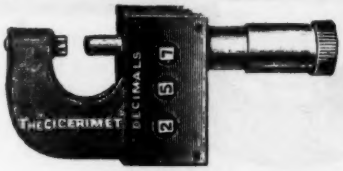


FIG. 18.

The exact measurement in decimals is automatically and accurately recorded in clear figures on the index, these readings responding in either direction to the most delicate movements of the screw. The readings are indicated on three revolving dials, the first figure (reading from the left-hand) indicates *tenths*, the second *hundredths*, and the third figure *thousandths* of an inch. One thousandth of an inch is technically known as "one mil," consequently these units, for conciseness, are frequently described as "mils."

Two principles are involved in the construction, (1) a screwed spindle travelling in a fixed nut and fitted into the body of the frame; (2) working in conjunction with, and actuated by the micrometer-spindle through the medium of an internally slotted-sleeve, is the counter or registering mechanism. When the instrument is manipulated so as to increase the gauge the counter moves forward, and if manipulated so as to decrease the gauge the counter moves backwards.

The gauge consists of a horseshoe body, having an internally screwed shank or fixed nut, to carry the micrometer-spindle and a recessed portion to receive or contain the mechanism, which is in turn covered by metal plates, the barrel-sleeve,

the anvil, and the *movement* or indicating mechanism, which is self-contained in an independent cage-like frame.

The mechanism is operated in the following manner :—The figures appearing in bold relief on the micrometer index are automatically displayed in decimal progression in a step-by-step motion, as clearly as if written. They are actuated by the rotation of the micrometer-spindle, which in turn drives a train of gear wheels and a cam-wheel, and upon the arbours are mounted circular white collars or dials, having black figures on their periphery. On the micrometer-spindle is fitted the slotted-sleeve, upon which is mounted the units-dial and also the first driving-wheel.

The connection of the measuring-spindle to the registering gear is effected by means of a projecting stop or key fixed on the unthreaded portion of the spindle, which engages with the slotted-sleeve imparting a rotatory motion, and at the same time the key is absolutely free to travel transversely in the slot, in relation to the movement, when the screw-spindle is rotated so as either to increase or decrease the gauge.

The different wheels operate in the following way, viz. :—

The gear-wheel, which is mounted on the slotted-sleeve, drives the hundredths dial, controlled through the intermediate pinion and cam-wheel, which latter imparts the step-by-step motion, and also alternately operates as a locking-cam ; and in like manner a further train of wheels transmit a similar step-by-step motion to the tenths dial. The pitch of the micrometer screw is one-fiftieth of an inch. The shank-sleeve is so disposed as to *protect* the micrometer screw against injury and also to exclude dust or dirt. A knurled head is situated on the outer end of the sleeve, and when manipulated drives the spindle through the friction of a small spring which is interposed ; hence it is impossible with ordinary care to strain the screw, since as soon as the pressure becomes too great, the spring yields to the resistance and allows the sleeve to slip.

The friction actuating the rotation of the spindle being constant, the pressure remains the same, whether the instrument is manipulated with a strong or a light touch.

This gauge is also made for metrical measurements. The No. 6 gives direct reading to the one-hundredth of a millimetre.

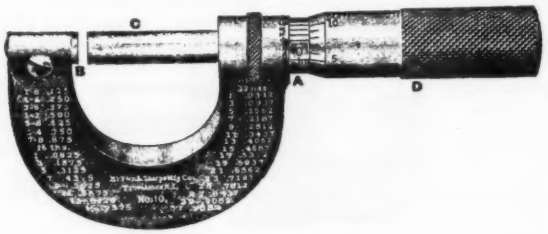


FIG. 19.

Fig. 19 represents a screw micrometer gauge (No. 10) by Brown & Sharpe.

The chief mechanical principle embodied in its construction is that of a screw free to move in a fixed nut, as in the Cicerimet just described. The measuring screw is cut on the concealed part of the spindle C, and moves in the thread tapped in the hub A. The hollow sleeve or thimble D is attached to the spindle C, and covers and protects the gauge screw. By turning the thimble, the screw is drawn back and the gauge opened.

The pitch of the screw is 40 to the inch. The divisions on the hub A, or the fixed spindle, in a line parallel to the axis of the screw are 40 to the inch, and figured 0, 1, 2, etc., at every fourth division, to indicate the tenths of an inch. Each rotation of the thimble shows on the scale that the tool has been opened $\frac{1}{40}$ or $\frac{25}{1000}$ of an inch. The bevelled edge of the thimble is divided into 25 equal parts, and figured at every fifth division, 0, 5, 10, 15, 20. Each division, on reaching the scale line on A, indicates that the screw has made $\frac{1}{25}$ of a turn and the opening increased by $\frac{1}{25}$ of $\frac{1}{40}$, or $\frac{1}{1000}$ of an inch.

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